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[OFFICIAL NOTICE.]

The Thirty-First Annual Meeting of the New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Jan. 8, 1901.

The thirty-first annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Mass., February 19th and 20th, 1901.

N. W. GIFFORD, Secretary.

[OFFICIAL NOTICE.]

Eighth Annual Meeting, Michigan Gas Association.

MICHIGAN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
ANN ARBOR, MICH, Jan. 28, 1901.

To the Members of the Michigan Gas Association: The eighth annual meeting of the Michigan Gas Association will be held in Grand Rapids, Mich., on Wednesday and Thursday, February 20th and 21st. The headquarters will be in the Morton House, where the meetings will also be held.

The following papers will be presented:

"Neglected Opportunities;" by Mr. B. C. Cobb, Detroit, Mich.

"Inclosed Cluster Lights with Self-Igniters;" by Mr. A. L. Zwisler, Kalamazoo, Mich.

"Street Maps: Their Use and Abuse;" by Mr. Paul Challis, Adrian, Mich.

"New Business;" by Mr. J. C. Sloan, Port Huron, Mich.

"The Relation of Heating and Illuminating Gases, Especially as Applied to Incandescent Mantles;" by Mr. Herman Russell—Mr. Russell is the bearer of the Michigan Gas Association Scholarship in the University of Michigan.

A number of short topics will also be offered and discussed.

The rates secured by the committee having the matter in charge, for the accommodation of the members and the Association's guests at the Morton House, are: $2.50, $3 and $3.50 per day—the last rate affording a room and bath. The best accommodations are always secured by writing in advance.

HENRY W. DOUGLAS, Secretary.

[OFFICIAL NOTICE.]

The Ohio Gas Light Association.

OFFICE OF THE SECRETARY,
DELAWARE, OHIO, JANUARY 25, 1901.

Believing that the sale of gas is one of the most important branches of our industry, this Association has established an Advertising Department.

Every man in any way interested in the gas business should lend a helping hand and co-operate with us in this new venture.

Work for the good of the cause and send, at your earliest convenience, any advertising idea or scheme of which you may know, to Mr. B. W. Perkins, South Bend, Ind., Editor of the Department.

T. C. JONES, Secretary.

BRIEFLY TOLD.

OBITUARY NOTE.—MR. THOMAS K. LEES.—Mr. Thomas Knott Lees, whose practical experience in the accounting division or section of the gas supply of New York city dated from 1860, died at his home, No. 5 Monroe place, Brooklyn, January 24th. Deceased was born in Connecticut, in 1820, where his early training was gained in the mercantile line, much of which training was acquired in New Haven. Certain manufacturing owners of his native State, had luckily gotten hold of an interest in the gas trading of New York city, and through their influence, in or about 1861, he was "called" to the position of Secretary of the New York Gas Company. Mr. William W. Fox, the President of the Company who died the evening of March 1st, 1861, was succeeded in the Presidency by Mr. C. L. Everitt, who had acted as the Company's Secretary, and Mr. Lees followed Mr. Everitt in the Sec retaryship. It is well within the writer's personal knowledge to have seen Mr. Lees presiding over the Company's clerks, in the gallery of the old church at Elizabeth and Hester streets, which, through the exigencies of trading, finally became the main business office of the old New York Gas Light Company. On the death of Mr. Everitt, Mr. Lees (1874) was elected to the Presidency of the Company, remaining as such until 1884, when it was absorbed as a member of the present Consolidated Gas Company. On the completion of the consolidation (Nov. 10, 1884), Mr. Lees was elected First Vice-President of the Company, and as such he remained to the end of his time. Mr. Lees was in no wise connected with the engineering division of the Company, but was noted in his gas practice for presumed ability to negotiate a bargain. He was in a quiet way prominent in the social life of Brooklyn, where he will be much missed by those with whom he fraternized in membership in the Long Island Historical Society and in the Institute of Arts and Sciences. He was also a member of the National Civic Club. He is survived by a son and a daughter. The former is the clever, capable gentleman who conducts the engineering division of the Consolidated Company's works at the east foot of 21st street. The funeral services were held in the Church of the Holy Trinity, Brooklyn, the afternoon of Jan. 26th. Interment was made in Greenwood Cemetery.

THE ORGANIZATION OF THE CONSOLIDATED GAS COMPANY.—Last week we noted that the only change in the Trusteeship of the Consolidated Gas Company of this city was the substituting of Mr. F. E. Tilford for Mr. H. Auchincloss. The Trustees subsequently perfected this executive organization: President, Mr. H. F. Gawtry; First Vice-President, Samuel Sloan—vice, Mr. T. K. Lees, deceased; Secretary, Mr. L. B. Gawtry—he is a son of the President; Assistant Sec retary, Dr. James A. Bennett. Mr. O. F. Zollikoffer, declined a re-election to the position of Secretary, a post that he filled with discretion and zeal for many years. The incumbent of the Treasurer's position was not disturbed. It was hoped by many that Dr. Bennett would have been appointed Secretary, but the men in control seem to have thought otherwise. It is thus a fact that the Company honors age and appreciates youth in its selections, as seen in the respective promotions of Mr. Sloan and Mr. L. B. Gawtry. A rather queer thing in connection with the gathering was the absence therefrom of Trustees Palmer, Whitney, Brady and Ryan.

NOTES.—Mr. John K. Russell has been appointed Superintendent of the Sheboygan (Wis.) National Gas Company, vice Mr. William I. Battin, resigned.——Mr. J. H. Findlay has obtained the right to represent the Kern Incandescent Gas Light Company's systems in Pittsburg and Allegheny City, Pa.——Write to the D. M. Steward Manufacturing Company, of Chattanooga, Tenn., for a copy of its calendar for the current year. The subject of its engraving is a popular one.——Mr. J. Charles Ross, formerly Superintendent of the New York Suburban Gas Company, of Port Chester, N. Y., has been appointed Superintendent of the American Gas Company's properties at Steubenville, O.——The works of the Poughkeepsie (N. Y.) Gas Company were badly damaged the night of January 25th by an explosion in the generating room. Superintendent Hadden is of the opinion that malice caused the upheaval.

Central Station Heating Problems.

[Prepared for the JOURNAL, by JAMES C. BAYLES, M.E., Ph.D.]

Some of the anxious problems of central station heating, as brought out in the informal discussions of the Heating and Ventilating Engineers, at their recent New York meeting, are of greater importance than those which have been more written about. These are eminently practical problems, and concerning them it is desirable the public shall know no more than it can find out. They relate to such details as pipes, couplings and insulation. Until they are solved it will be an open question with the initiated whether the distribution of steam and hot water for power and heating purposes can be considered as having reached a stage of development beyond the crudely experimental. It is also a question whether the public advantage of such a distribution is not fully offset by the evils directly traceable to it, as the result of conditions which, in the present state of the art, seem to be inseparable from the underground piping of highly heated fluids.

What kind of pipes shall be used? Naturally enough, perhaps, the engineer started with wrought iron and steel pipes. They suited him exactly, and, after the manner of his kind, he rushed in "where angels fear to tread." Experience has shown him that the life of such pipes is a matter of great uncertainty. Their behavior is so unequal as to be extremely confusing. Sometimes they endure beyond all reasonable expectation, showing neither internal nor external corrosion after long use. In other cases they give out so quickly that the costs of replacements are a heavy item of maintenance charges. Prof. R. C. Carpenter tells of a case under his personal observation and professional charge in the college plant, in which the renewals of pipes destroyed by perforation amount to about 10 per cent. of the pipe system annually. This is a serious matter from every point of view, since to the cost of pipes and labor must be added the interruption of service while locating and replacing pipes which give out. The trouble occurs both in flow and return pipes, but is most pronounced in the case of pipes carrying the water of condensation. It takes the shape of "pin-holing;" but one instance is recorded in which the engineer, instead of replacing pipes which became leaky from this cause, simply closed the leaks by going over the pipes with a pene hammer. The holes did not reappear, from which it is concluded that the action was not continuous—a curious phenomenon, certainly. It is believed that the chemical composition of the metal, and especially the amount of carbon it carries, determines the life of pipes in this service. As the old lady asked: "If it is not that, or something else, what is it?" Speculation as to the reasons for things is always interesting, even though it does not lead to anything conclusive. Manganese has also been held responsible for the tendency of steel pipes to become diaphanous, but as it occurs in iron as well as steel, and as iron does not carry manganese worth mentioning, the proponents of this explanation had to guess again. No doubt the composition of the metal has a great deal to do with its life under these or any other conditions; but since the engineer has no way of telling how a given lot of pipes will behave in use, cannot get his pipes made to a formula, and would not know what to prescribe if he could, speculation does not seem to help him much. About the only thing he can be sure of is that the chances are overwhelmingly in favor of his being disappointed in the life of any kind of pipe he may select. The rapidity with which wrought iron and steel pipes are destroyed by the water of condensation in connection with a steam plant, has puzzled a great many people, but it seems to be a perfectly natural phenomenon, involving no mystery. This form of water is purer than any natural water, rain water not excepted. It is a well known fact that water acts on metals more or less vigorously in proportion to its purity; or, at least, its freedom from mineral constituents. The reason that live steam pipes are less rapidly destroyed than pipes which convey the distilled water of condensation is probably due to the fact that in steam the oxygen is held in such shape that it cannot leave the hydrogen for the iron, notwithstanding its strong affinity for the latter; whereas, in the water of condensation it is held only by its weak affinity for hydrogen, and, having no other base with which to combine to form a salt, it "goes for" the iron like a mongoose for a snake. But however this may be, the fact is as we have stated, and as a consequence the confidence of the central station engineer in welded pipes, of either iron or steel, is shaken. Experience has also shown him that the screw joint, which in some respects meets his requirements admirably, is after all a weak point in his system. Corrosion begins at the heel of the thread, and usually continues until the pipe line, which may be otherwise perfect, separates at these zones of disintegration.

A consensus of opinion among engineers connected with central station heating enterprises shows a substantial agreement that cast iron pipes are altogether the best for use in plants of this character; but how are they to be coupled? That question has bothered others, we believe. The hub and spigot joint is not practical. Lead cannot be used with hot pipes; cement is open to the same objection, and rust joints burst the hubs. One engineer of this class of work buys cast iron column pipe, has it threaded and uses a heavy cast iron screw coupling. He claims to get good results, but his example is not being imitated generally. None of the expedients thus far suggested are satisfactory. As a pipe, the cast iron cylinder, considered as an isolated unit, is all right; but the practical cast iron pipe line is still an unsolved problem for the central station engineer.

Concerning insulation, the specialist in this field thinks much and says as little as possible. There are facts in every business concerning which "the golden silence of the Greek" is discreet. The loss from leakage and condensation ranges from 5 to 35 per cent., according to the age of the plant, and the amount currently expended in repairs. Mr. W. H. Bryan, of St. Louis, who is probably as good an authority as we have on central station heating practice, says: "Under no conditions should it exceed 25 per cent." With this sapient generalization no one will be likely to differ. Leakage and condensation mean, chiefly, defective insulation, the least serious aspect of which is the loss of heat. The creation of high temperatures in the ground plays havoc with gas mains, water mains and all forms of underground conduits, which are thus rendered subject to conditions for which no provision is made in laying them. The greatly increased range of temperatures to which their proximity to sizzling steam and hot water pipes exposes them, increases expansion and contraction, inducing leakage and fracture. There are places not inaccessible by public conveyance from the office of the AMERICAN GAS LIGHT JOURNAL, where, in consequence of the radiation from buried steam mains, the lead protrudes from ¼ to ½ an inch from the hub of every gas main, and where water is usually drawn at temperatures ranging from 80° to 100° F. As there are times, and many of them, when, for one reason or another, the steam is shut off from the mains, the strain on the gas and water pipes is very severe. Indeed, it is a grave question whether franchises for central station heating should be granted in cities where the hot mains must parallel those which depend for the maintenance of their integrity upon the least range of temperature possible. The electrical plants which are thus making merchandize of their exhaust steam, may find it profitable under favorable conditions; but it is a safe generalization that every dollar they make in this way costs the public $100 in damage to other and more important public utilities. Between high ground temperatures and electrolysis, the life of a gas or water main, like that of the policeman, "Is not a happy one."

The Present Problem in Technical Education.

Engineering Record says that the recent publication of the report of the discussion on American industrial education at the last meeting of the Society for the Promotion of Engineering Education is most timely. The *Engineering Record* can bear testimony to the wide extent and surprising unanimity of the opinion of engineers that no more high class technical schools are needed now. The correspondence on the subject when Mr. Carnegie announced his purpose of founding an industrial school left no doubt concerning the views of practicing engineers; the pamphlet just issued shows that the instructors in polytechnic institutions incline to the same view. All information and discussion bearing on the subject is particularly important, because of the present unbalanced condition of our educational system. Its unsatisfactory condition demands attention if any real improvement is to be made.

Our public school system is generally accepted as a good one by those who have watched its results most carefully. It provides sound training in the three r's in the grammar grades, and gives an education in the high schools of the large cities which compares favorably with a course in the small colleges a quarter century ago. This training is, however, only for those pupils who are being fitted for college or technical school or those whose parents can afford to put off the time when they must begin to earn a living. In some cities there are already English high schools and scientific high schools. These do not owe their existence to any general desire to teach "useful" subjects, for public taxation to teach trades or callings is contrary to the spirit of American institutions. They have been established because the accepted meaning of liberal educatiou has shifted from instruction in a narrow curriculum to training in any way which gives the student a fairly well balanced habit of thought, a liberal view of the duties of life and ability to discharge them. This scheme of education, beyond the grammar schools, is of advantage, then, to two classes; those fitting for colleges and technical schools and those who are not obliged to go to work just as soon as possible.

This school organization naturally enough tended to develop the technical school very rapidly. It was, in some degree, a competitor of the college rather than the medical and law schools. To people educated in colleges it seemed impossible that the mental training of a technical graduate could be so liberalizing as that of the college. There was supposed to be a subtle something in a knowledge of dead lauguages, history and philosophy which could not be afforded by modern languages, by the history of our own times and by science. So the technical schools constantly strove to maks the courses so complete and so strong that no impartial observer could deny their equality as educational institutions with the older schools. They have proved their contention; even the conservatism of German scholarships has acknowledged this. Of course both college and technical courses are desirable, if a student can afford time and money for them, but it may be accepted as a generally acknowledged fact that they are equal as methods of mental training. As a result of this competition with the college and in the more recent competition among themselves, the technical courses now demand entrance requirements which are very high and an expenditure of time and money that is not warranted except for a comparatively few students, and it is this development under stress of competition which has left a gap in our educational system.

The boy finishing the grammar schools, who has marked technical ability but can be supported for only a few more years by his parents, has no school open to him where he can acquire the elementary scientific knowledge and business principles essential for success in most trades. Some of our clear headed men of affairs recognized this long ago and provided for it in the schools they helped to establish. But the idea has been buried until recently, and only now has its importance been felt. Dr. Thurston has called attention to the views of both Cornell and Sibley on this subject in a report from which the following quotation, previously unpublished, is here reproduced: "The schools of mechanic arts contemplated by the founders were such as would suitably prepare youth for positions as superintendents and foremen in the various mechanical industries. They were neither trade schools of the lower sort nor manual training schools such as are now not uncommon in the larger cities. * * * Their scope is as broad as the whole system of our national industries and even wider; since they should include such foreign industries as it is most desirable that our people take over into our own system. Their output should be a body of directing spirits which should find place in every workshop, mill and factory in the land and which should steady and energize every working force in every branch of industry. A thousand such are needed where a score such men as graduate from our engineering schools are required."

That such schools are most needed to-day seems evident from the opinions received from many sources able to form a sound judgment. The extraordinary and continued growth of correspondence schools is a proof of this statement. Anyone who will take the trouble to witness a few recitations at Cooper Union, New York, will see another proof. There is a great class, including boys who have finished grammar schools and running up to men of middle age, who are willing to work hard for a limited scientific training, enough to apply their practical knowledge to the best advantage. They do not need trade schools and they do not need the fireworks of the new century laboratory equipment.

The great trouble in trying to fathom the character of instruction needed by this enormous class has been the preconceived ideas of some of the investigators. Mr. R. W. Rothwell emphasized this point very strongly in his contribution to the discussion of the Society for the Promotion of Engineering Education. He said, and many people have said it for him: "There are not a few of our large colleges whose courses are designed by gentlemen of great learning but who have never had to earn their living by labor in the occupations they are teaching. These gentlemen evolve more or less from their inner consciousness what a young man or woman should learn, and not infrequently when these young people get out in life and have to earn their living they find that they should have learned something very different. The best way to know what ought to be taught in any subject is to go to men who are earning their living in that occupation and ascertain what will enable them to earn more. * * * The

methods of teaching should be adapted to the people taught. The speaker doubted whether the very learned and able gentlemen who are teaching in Columbia University, and there are no better in the world, would at all make a success of correspondence education. To do this one must understand the people who are being taught. The secret of success is to find the men who can teach the industrial classes. These teachers should have been brought up with them and have learned how to reach them; should have, as it were, their range and be able to hit them."

That there is a need for industrial education of a character not supplied as yet must be evident, and that it must differ from the education of a modern technical school is equally evident. It must be elastic, must begin way down with arithmetic and be carried up without a single superfluity of any sort to the laboratory and shop. What its exact extent and nature should be cannot yet be determined, and it is suggested that the Society for the Promotion of Technical Education can undertake no more promising investigation than a careful survey of this field by means of a large committee including, with members of the Society, employers and employees whose positions enable their advice to be of value. A painstaking investigation of this nature, careful and thorough, would be an eminently fit beginning of the twentieth century's educational history.

London Street Problems.

By "B."

It is quite usual for those who do not know much about it to complain of the reckless inroads of corporations, enjoying municipal franchises in American cities, upon the public rights, in the matter of tearing up and obstructing the streets, etc., and to point to London, England, as affording an example of how such things should be managed. Those who have visited London, and think they "know all about it," tell us that one never sees the streets of that city torn up, and the works necessary to the public convenience are carried on so smoothly and expeditiously that no annoyance results; all of which is about as far from the truth as can well be imagined. In point of fact, such matters would appear to be managed very poorly in London. The last annual report of Mr. Weaver, Borough Engineer of Kensington, throws some light on how things are done in his part of the city, and is both interesting and instructive. Among other things he tells us that, in September, 1899, the Works' Committee of the Kensington Vestry received notice that the General Post Office authorities were about to lay 9 miles of trunk telephone mains in the borough, with access manholes about 150 yards apart. Many of the roads indicated had only lately been restored to a safe condition after the execution of a similar work by the National Telephone Company. Consent was given and permits issued, but, up to the end of 1900, the work had not been begun. As the result, necessary repairs have been postponed, and many of the thoroughfares thus placed under the ban are in very bad, even dangerous, condition. They are not put in order for the reason that if, after a considerable expenditure for this purpose, the postal authorities should begin operations, as they are liable to do at any time, the ratepayers would complain bitterly. As it is, they complain of the condition of the streets; so that the choice of the Vestry would seem to be that between the devil and the deep sea. This does not look like the ideal municipal management we hear about.

Paving and street cleaning are anxious problems in London, as well as in New York and other American cities, and apparently for much the same reasons. In regard to the maintenance of highways in a satisfactory condition, Mr. Weaver waxing humorous, expresses himself in the following characteristic language:

"Methods which satisfied the most exacting section of the public in 1860 would not be tolerated by a tramp in 1900. Whether the ideal state of things portrayed by the facile pens of critics will ever be attained is open to doubt? If it is reached, however, there will be nothing ideal about the cost—that will be very real. In addition to perfection of cleansing, guided by prophetic instinct as to weather, another public demand, urgently pressed, is for a really good road pavement, equally suitable for horses and all descriptions of vehicles, including cycles, and free from mud, dust, slipperiness, surface water and smells, at all times. The conflicting requirements involved in this demand will be adjusted about as easily, I think, as the satisfaction of that long felt want—a palatable drink, equally attractive to the confirmed drunkard and the the total abstainer, and good for both."

There is a lightness of touch in this, verging on airy persiflage, which is sadly lacking in most American reports. The Englishman may "take his pleasures sadly," but he could not very well take one of Mr. Weaver's reports in that way, even if a ratepayer.

In handling snow, New York can give London points and win out easily. It is not probable that Kensington is behind other boroughs in this respect. The first considerable snow-falls, after the passage of the Public Health Act of 1891, under which the removal of snow from sidewalks became the duty of the public authorities, occurred in January and February of last year. They paralyzed the vestries and showed that the law, while very good in theory, was impracticable of enforcement. A snowstorm since the beginning of the present year has emphasized this conclusion.

On the whole, it does not appear that the residents of American cities have a monopoly of discomfort in connection with street disturbance and municipal incapacity in dealing with public works. It is sad to have the illusion dispelled that venerable London has reached a state of rest, with everything complete, perfect, finished; with a public administration beyond criticism; but if local data are trustworthy they have troubles of their own, which are much like ours, both in kind and degree. The chief difference would appear to be that while London has as many inconveniences as New York, it has decidedly fewer conveniences to balance the account.

Crossley Gas Engines and Pierson Gas Producers at the Cassel Tramways.[1]

We have received from Messrs. J. and O. G. Pierson, of 54 Faubourg Montmartre, Paris, a report, of which the following is a translation, made by M. Aimé Witz, of a test of Crossley gas engines and Pierson gas producers at the power station of the Cassel Tramways (Cassel, near Lille, France):

The electric generating station of the tramway company of Cassel is supplied with "poor gas" by a gas plant working on the system of Messrs. J. and O. G. Pierson, and installed by them, comprising two steam boilers, two producers, and scrubbing and purifying apparatus. The second boiler and producer are in reserve. The coke column, which acts as scrubber, is supplied with water from an elevated reservoir holding 500 liters, to which a special pump raises the water from a cistern. The boilers, working at a pressure of 6 kilogrammes 85 pounds), have each a feed pump drawing water from a special tank.

The air is blown into the producers by steam injectors in which the proportions of steam and air can be adjusted as desired, in order to produce a gas of constant quality, whatever may be the rate of consumption. Various apparatus enable the attendant to take account at any moment of the working of the apparatus, by observation of the temperature, pressures, purity and richness of the gas, etc. The whole plant is well constructed and installed.

The engines are of the Crossley type, three in number, and are guaranteed to give, with "poor gas," 26 effective horse power, with an extension to 31 horse power in case of need. The diameter of the cylinder is 29 2 centimeters (11.49 inches), and the stroke of the piston 53 34 centimeters (21 inches), while the revolutions are 170 per minute. The diameter of the flywheel is 1,880 meters (74 inches). The three engines are identical.

The cooling of the cylinders is effected by means of a thermosyphon, comprising a tank of 22 cubic meters (777 cubic feet) capacity, and a reserve cistern of 30 cubic meters. The makers guarantee that this quantity of water will suffice for two engines working continuously for 15 hours in summer. The only additional water needed is to compensate for losses and to feed the steam boiler connected with the producer. There is very little water available at the site of the station, and it would have been impossible to have employed steam engines there.

The gas engines drive, through belting, a line shaft, making 360 revolutions per minute, from which there are driven two dynamos, one of them being in reserve. The electric generators, constructed by the Société Alsacienne de Constructions Mécaniques, can each supply 60 amperes at 700 volts when running at 750 revolutions per minute, and their guaranteed efficiency at full load is 91 per cent. There is a battery of accumulators which is charged when the traffic takes less than the output of the dynamo, and which discharges when the demand for current is great. This action is automatic, and the demand on the gas engines is almost constant.

The profile of the line is very irregular. The town of Cassel is 111.55 meters (366 feet) above the railway station, and that difference of level is irregularly distributed over a length of 3,365 meters (2.08

1. From *Engineering*.

miles), which includes gradients up to 62 per 1,000 (1 in 16). The power required to drive a car is, therefore, very variable. Messrs. Pierson guaranteed for the engines a constant speed, without any attention of the man in charge, even if the battery should be put out of action. The consumption of coal was guaranteed to be less than 800 grammes (1.76 pounds) of dry coal per effective horse power hour, without any deduction besides that for humidity, provided that the ash did not exceed 10 per cent. The consumption at the boilers is included in the figure, and it was agreed that no account should be taken of the power expended in feeding the boiler or raising the water.

I proceeded to the verification of these guarantees by two series of trials, the one made under the actual working of the tramway, and the other at maximum work with a water resistance, to determine the consumption per kilowatt hour and per effective horse power.

Trial in Actual Service.—The trial was made on August 28, from 7 A.M. to 11.30 A.M. In addition to the tramway service we sent up to Cassel town, and brought down again, a goods wagon (*fourgon auto moteur*) charged with nearly 2,500 kilogrammes (2½ tons) of dead weight. We have worked out with care the data relative to these two journeys, as well as those of the journeys of a passenger car with passengers in the two directions. The figures are subjoined:

Ascent of Wagon.—Time, 20 minutes 30 seconds = 1,230 seconds = 0.342 hours.

	Number of Revolutions per Minute.	Number of Admissions.
Engine A	167.1	42
Engine B	165.0	41.4
Total indicated power		42.06-horse power
Maximum current		110 amperes
Corresponding voltage		475 volts
Maximum electric power		52.25 kilowatts
Mean amperes		49.43
Mean volts		517
Watts		25,555
Total electric power		8.73 kilowatt hours

The curve 1 of the annexed diagram (Fig. 2) represents the ascent by

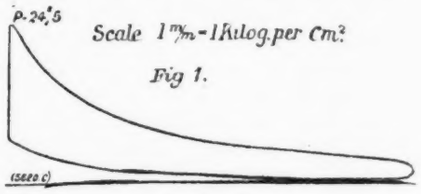
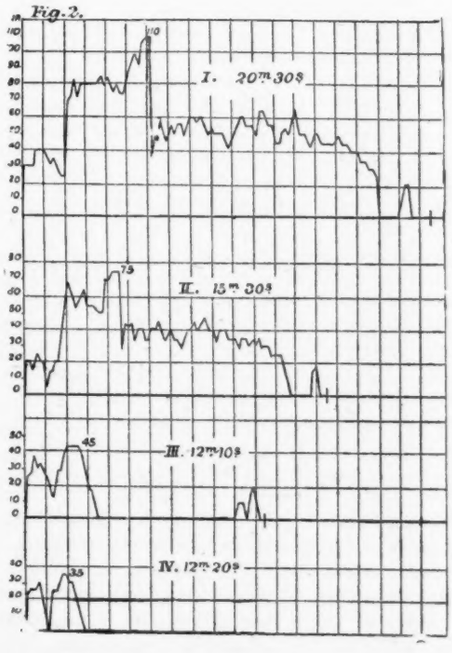


Fig 1.

Fig. 2.



the variation of the amperes read every 10 seconds; the curves II., III. and IV. apply to the following journeys:

Ascent of Passenger Car (II.)—Time (duration), 15 minutes, 30 seconds = 930 seconds = 0.258 hour.

	Number of Revolutions per Minute.	Number of Admissions.
Engine A	170.00	43.1
Engine B	169.67	41.1
Total indicated power		41.34 horse power
Maximum current		75 amperes
Corresponding voltage		495 volts
Maximum electric power		37.35 kilowatts
Mean amperes		34.20
Mean volts		522
Watts		17,853
Total electric work		5.06 kilowatt hours

Descent of Wagon (III.)—Time (duration) 12 minutes, 10 seconds = 730 seconds = 0.203 hours.

	Number of Revolutions per Minute.	Number of Admissions.
Engine A	167.2	41.1
Engine B	167.0	37.1
Total indicated power		38.2 horse power
Maximum current		46 amperes
Corresponding voltage		525 volts
Maximum electric power		23.62 kilowatts
Mean amperes		9.36
Mean volts		542
Watts		5,084
Total electric power		1.19 kilowatt hours

Descent of Passenger Car (IV.)—Time (duration) 12 minutes 30 seconds = 740 seconds = 0.206 hours.

	Number of Revolutions per Minute.	Number of Admissions.
Engine A	161.5	42.6
Engine B	161.3	38.6
Total indicated power		39.6 horse power
Maximum current		35 ampers
Corresponding voltage		545 volts
Maximum electric power		19.07 kilowatts
Mean amperes		5.33
Mean volts		557
Watts		2970
Total electric power		0.59 kilowatt hour

In the interval of the traffic the engines made about 165 revolutions per minute, and they developed 39 indicated horse power with 40 admissions per minute; the instruments registered from 25 to 35 amperes at 540 to 565 volts. The gas from the producer preserved a constant mean value corresponding to 1,243 calories per cubic meter at 0° C. and 760 millimeters of pressure at constant volume and with the water vapor condensed. This thermal value was determined in my laboratory at Lille by the aid of the eudiometric bomb.

The number of diagrams taken in the course of these trials testify to the uniformity of the quality of the gas; below are the mean pressures in kilogrammes per square centimeter,[1] maximum and minimum, of four series of diagrams:

	I.	II.	III.	IV.
Mean pressure	6 38	6.17	6.16	6.15
Maximum pressure	6.52	6.36	6.21	6 24
Minimum pressure	5.28	5.98	6 10	6 03

One of the diagrams is annexed; the successive curves cover each other perfectly. For a compression equal to 6.5 kilogrammes per square centimeter (92.5 pounds), the explosive pressure is 24 5 kilogrammes (348 pounds).

An ascent of a car was made by coupling 3 engines and cutting out the accumulators. The service was made regularly, although the output of current became *nil* at times. The operation of the station is thus rendered sure in case the battery should break down. When driving the shafting and 1 dynamo, with the brushes raised, the engines maintained a mean speed of 171.5 revolutions, with 16.1 admissions each; the engine C running empty without belt, made 167.6 revolutions with 10 admissions. In the first trial the power absorbed by the transmission and 1 dynamo was 14.68 horse power; in the second the indicated power absorbed by an engine running light was 4.56 horse power. The power absorbed by the shafting and belts, and by the armature of a dynamo, may be estimated at $14.68 - 2 \times 4.56 = 5.58$ horse power. For an effective power of 30-horse power the organic efficiency of an engine would be 85 per cent. $\left(\frac{4.56}{30} = .15\right)$. The small amount of power absorbed by the transmission when running light proves that it was under the best conditions, and that it was properly erected.

II. *Trial of Consumption.*—A 6 hours' trial was made by utilizing the current in a liquid resistance of a solution of sulphate of soda. The engines A and B drove the left hand dynamo. The combustible

1. One kilogramme per square centimeter equals 14.223 pounds per square inch.

employed was slack (*braisette Lagrange d'Anzin criblée a* 30/50) riddled, and containing nearly 10 per cent. of ashes. It contained 1 per cent. of humidity, the weight of a hectoliter (3.53 cubic feet) being 76.5 kilogrammes (168.6 pounds). The producer was already in operation, and the only preparation was the clearing of the fires. It was in the same condition of working and of fire at the end of the trial. The boiler was heated by the small fuel, of which a part came from the riddlings of the slack, and the cinders extracted from the ashes of the producer.

There was consumed in 6 hours: 146.5 kilogrammes (323 pounds) of slack, or, if the humidity be deducted, 145 kilogrammes, in the producer, and 57 kilogrammes (125.6 pounds) of small under the boiler, which makes 202 kilogrammes in all, corresponding to 33 6 kilogrammes (74 pounds) per hour.

The engines gave the following result:

	Number of Revolutions per Minute.	Number of Admissions.
Engine A.....	165 82	68 31 out of 82 91
" B.....	166.42	63.25 " 83 21

On an average there were 65.73 admissions to 83.06 cycles—that is, 79 per cent.; the engines were not working at full power.

The mean pressure of the diagrams was 5.98 kilogrammes (13.18 pounds) for engine A, and 5.51 kilogrammes (12.12 pounds) for engine B, which gives 32.4-horse power for engine A and 27.68-horse power for engine B, or altogether 60.08 indicated horse power for the 2 engines. Deducting for this figure $2 \times 4.5 = 9.12$ horse power absorbed by the friction of the engines, there remains 59.06 horse power available at the shaft. The effective horse power then requires a consumption of 559 grammes (1.23 pounds) of fuel, without deduction of ash and cinders, the latter being utilizable.

The electric instruments showed:

Mean amperes.....	64 54
" volts	484.7
" kilowatts.....	31.282

The consumption of coal per kw hour was $\frac{33.6}{31.28} = 1{,}073$ grammes (2.36 pounds).

The guarantees given by MM. Pierson were thus more than realized, as regards the consumption. The working of the engines and the producer was further irreproachable (*irréprochable*) during the trial. The consumption of water vaporized under a pressure of 4.5 kilogrammes (63 pounds) was 37.6 kilogrammes (82.9 pounds) per hour. The quantity is very small. It is to be observed that there is not any other expenditure of water.

We made a curious experiment relatively to the condition of the fire in the producer during stoppages; it was possible to set again in action, after a short air-blowing, a producer which had been out of action for 14 hours. This apparatus offers, then, great facilities in service, lending itself well to the operation of tramway stations in which the periods of stoppages are long. To maintain the fire during 14 hours, it was necessary to charge the apparatus with 21 kilogrammes of coal. It is true that the real consumption may be a little higher, seeing that we did not take count of the variation of the state of the coal inclosed in the producer at the moment of stoppage, it being inappreciable.

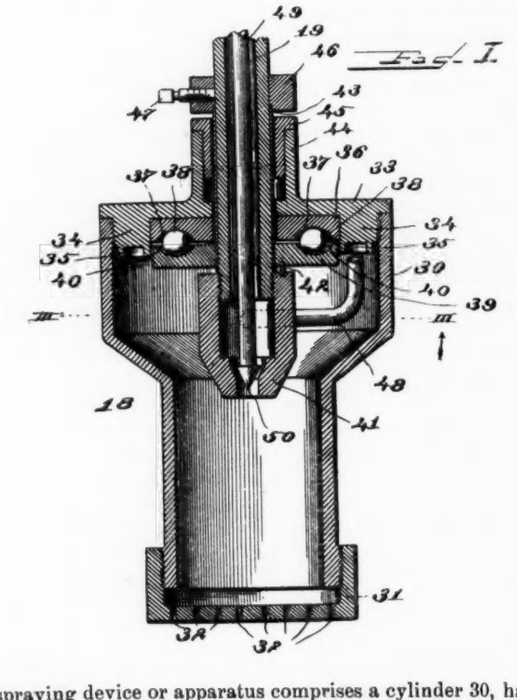
In conclusion, I declare the installation of the producers and engines made by MM. J. and O. G. Pierson, at the tramway station at Cassel, realizes amply the guarantees given, and conforms to the best conditions of power, of regularity, of elasticity, and of consumption.

Johnston's Liquid Spraying Device.

On November 20th, 1900, U. S. Letters Patent (No. 662,236) were granted to Mr. John P. Johnston, of Oak Park, Ills., for "new and useful improvements in liquid spraying devices." Using the words of the specification: The invention relates to apparatus that may be used for spraying or feeding liquids of various kinds, and which will efficiently spray the oil as it is introduced.

In the drawings, Figure 1 is an enlarged sectional view of the liquid spraying or feeding devices, and Fig. 2 is a section on line 3 3 of Fig. 1 looking up.

Referring to the drawings, 18 indicates the spraying or feeding apparatus, which may be supported in any suitable manner from a feed pipe or tube 19, that will serve as an inlet or conductor for the liquid to be sprayed.



The spraying device or apparatus comprises a cylinder 30, having its lower end of less diameter than its upper end and carrying at its contracted lower end a nozzle 31, provided with perforations 32 for the passage of the liquid. The nozzle 31 is preferably screwed upon the lower end of the cylinder to permit of its removal. At its upper end the cylinder 30 carries a head 33, screwed therein or thereupon. The head 33 is provided with an annular flange 34, which projects into the cylinder 30 and has in its lower face a series of cups or depressions 35, as shown in the drawings. Within the annular flange 34 is a hardened bearing plate 36, having a concave channel 37, as shown in Fig. 1.

The cylinder 30 is supported from the lower end of the tube 19 upon anti-friction balls 38, which run in the channel 37, and are supported by a bearing plate 39, having a similar channel 40, as shown in Fig. 1.

The bearing plate 39 is fitted closely upon the tube 19, and rests upon a nozzle 41, screwed upon the lower end of the tube 19 and keyed thereto by a pin 42. The tube 19 is stationary, and consequently the bearing plate 39 is also stationary.

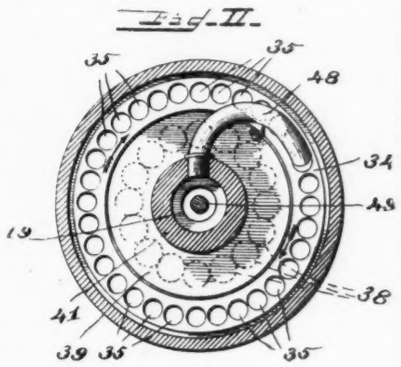
43 indicates a hardened cylinder which is fitted upon the tube 19 near the lower end thereof and forms a bearing for the head 33, which rotates, as will be hereinafter described. The head 33 is provided with an upwardly extending annular flange 44, which receives a bushing 45, fitted closely upon the cylinder 43. The latter cylinder is held in place by a collar 46, fitted upon the tube 19 immediately above the cylinder 43 and held in place by a set screw 47, as shown in Fig. 1. By this arrangement the cylinder 43 serves as a bearing for the head 33 and takes the wear. It may be removed and replaced simply by removing the collar 46 and bushing 45.

48 indicates a pipe which extends from the nozzle 41 to a point under the cups 35, said pipe extending upward to near said cups, and being inclined so that the liquid passing therefrom strikes said cups tangentially and causes the head to rotate.

49 indicates a valve stem which extends through the tube 19 from end to end, said valve stem having at its lower end a conical or needle valve 50, adapted to be seated in a suitable seat in the lower end of the nozzle 41, as shown in Fig. 1. The upper end of the valve stem 49 passes beyond the upper end of the tube 19 and may be provided with a hand wheel. (Not shown.)

The operation of this feeding and spraying apparatus is as follows: The feeding device being in the proper position liquid is introduced to tube 19, down which it flows under a pressure of from 15 to 80 pounds to the square inch when oil is to be sprayed. A small part of the liquid, usually about one-third of the quantity to be supplied, passes down through the nozzle 41, the needle valve being properly adjusted to that end by operating its hand wheel. The remaining two-thirds passes through pipe 48, and is discharged with considerable force, depending on the pressure, into the cups 35, causing the head 33 to rotate in the direction indicated by the arrow in Fig. 2.

The rotation of the head spreads the liquid over the interior surface of the cylinder 30, which rotates with the head 33. The rotation of the cylinder serves to scatter the liquid and causes it to hug the interior surface thereof. The liquid gradually passes down and out through the holes 32 of the nozzle 31 and is sprayed by the rotation of said nozzle. If when the apparatus is in operation it should be found that the proper quantity of liquid is not being supplied, the quantity may be varied without changing the pressure by adjusting the needle valve 50, and in practice I have found that said valve provides a sufficient degree of variation for all practical purposes, so that it is practically never necessary to vary the pressure of the liquid in order to properly regulate the quantity of liquid supplied. To adapt the apparatus for purposes requiring a very much greater or less quantity of liquid, it is necessary simply to vary the size of the pipe 48 through which the liquid is discharged against the cups; but under ordinary circumstances all necessary variation may be secured by simply adjusting the needle valve.



My invention includes such alterations and modifications as would occur to those familiar with the art, and is not limited to the specific devices or arrangement illustrated and described, except in so far as such features are specifically claimed.

The inventor's claims are:

1. In a liquid spraying apparatus, the combination of a feed pipe, a rotary cylinder, means for rotating said cylinder by the flow of the liquid thereinto, one or more passages for the discharge of the liquid from said cylinder, and means for varying the quantity of liquid supplied to said cylinder without varying the speed of its rotation.

2. The combination of a feed pipe, a rotary cylinder, means for injecting liquid tangentially into said cylinder to effect its rotation, additional means for supplying liquid to said cylinder, and one or more passages for the discharge of liquid from said cylinder.

3. The combination of a feed pipe, a rotary cylinder, means operated by the flow of the liquid thereinto for rotating said cylinder, additional means for supplying liquid to said cylinder, and one or more passages for the discharge of the liquid from said cylinder.

4. The combination of a spraying device operated by the flow of liquid, means for supplying liquid under pressure to said spraying device, and means for varying the quantity of liquid supplied to the spraying device without varying the pressure of the liquid herein.

5. The combination of a spraying device, means for conducting liquid to said spraying device, a plurality of passages for admitting liquid to said spraying device, and a valve governing the admission of liquid to one of said passages and not another.

6. The combination of a rotary cylinder, a supply pipe, a plurality of passages for admitting liquid from said pipe to said cylinder, and a valve governing the admission of liquid to one of said passages and not another.

7. The combination of a spraying device, means for conducting liquid to said spraying device, a plurality of passages for admitting liquid to said spraying device, a valve governing the admission of liquid to one of said passages and not another, and means for operating said spraying device by the flow of liquid.

8. The combination of a rotary cylinder, a supply pipe for conducting liquid to said cylinder, means for injecting liquid into said cylinder tangentially, separate means for discharging liquid into said cylinder, and a valve for controlling the latter discharge.

9. The combination of a rotary cylinder having an outlet or outlets for the discharge of liquid at or near the lower end of the cylinder, a pipe communicating with said cylinder for supplying liquid thereto, means operated by the flow of liquid for rotating said cylinder, and ball bearings supporting said cylinder from said supply pipe.

10. The combination of a rotary cylinder having a series of cups annularly arranged, a supply pipe, and a pipe affording communication between said supply pipe and said cylinder and arranged to discharge liquid from said pipe into said cups tangentially.

11. The combination of a rotary cylinder having a series of cups annularly arranged, a supply pipe, a pipe affording communication between said supply pipe and said cylinder, and arranged to discharge liquid from said pipe into said cups tangentially, and a separate valved passage between said supply pipe and said cylinder.

12. The combination of a supply pipe having an external sleeve fitted upon the lower end thereof, a rotary cylinder having its upper end fitted upon said sleeve, bearings supporting said cylinder and permitting its rotation, and means for discharging liquid from said supply pipe tangentially into said cylinder.

13. The combination of a rotary spraying head adapted to contain the liquid to be sprayed, means for supplying liquid thereto, one or more passages for the discharge of the liquid from said head, and means operated by a part only of the liquid supplied to said spraying head for rotating said head.

Central Station Switchboard Connections.

By Mr. J. A. Seager, in *Electrical Engineer*.

Among the minor points in central station design is the arrangement of the cable connections to the switchboard from dynamos, battery and mains. Although many other considerations claim precedence, it is essential that these leads should be well arranged, as economy both in first cost and in running expenses can be obtained, and, what is more important, mistakes of electricians and wiremen due to complexity of connections must be avoided. Without going much into detail, the following elementary points may be noted: Two different considerations govern the arrangement of high and of low tension connections. In the first, high insulation at every point is the chief aim of the designer. In the second, dealing with heavy currents, minimum copper resistance and good contact are the important objects. In high tension work stranded cable is almost invariably used, and in the majority of cases the cable is concentric. The insulating material should preferably not be rubber, as this deteriorates rapidly under such heat conditions as are found in cable trenches in stations. If used, the cable should be vulcanized. Whether the cable be lead sheathed or not depends on whether it is drawn into iron or pot tubes or cleated in a dry trench, or else laid in a trench imperfectly protected from moisture either from drains or escaping steam. The greatest care must be taken to prevent abrasion of the insulating material. Probably the best method for this purpose is to use a glazed stoneware tube, the cable being drawn into this. Next to this comes the employment of iron pipes. It should be remembered that there is a tendency for water to condense in the inside of these tubes and for grit to get in if they are left open, so that the ends should be closed with tarred wood plugs shaped to inclose the cable. The ends of the tube should be cupped outwards to prevent the edge of the tube cutting the insulation when the cable is bent about. If iron pipe is used for alternating current work, concentric leads are necessary, in order that the eddy currents generated by the "go" current may be eliminated by those of the "return." Iron pipe (which must, of course, be "barffed" or else coated with tar) is cheaper than stone ware. An alternative to iron or stone ware tube is, as mentioned above, a concrete trench. This is generally run along the dynamo ends of the foundations for the plant, and leads to the back of the switchboard or to a cable room beneath the switch gallery. It is made of sufficient capacity to contain all necessary cables placed well apart from one another, say 5 inches from center to center, with additional room for future extensions. In small stations, cast iron chequer plates, fitting into wrought iron seats, are placed over the trenches. Care should be taken to see that these are watertight, as cleaners have a tendency to slop water very freely about the floors. In larger stations it is found better practice to make the trenches large enough for a man to pass through easily without touching wires, and to cover the top of the trench with a brickwork or concrete arch leveled to the floor at the top. It is useful to construct the trench at the same time as the foundations, building into the latter wrought iron pipes having a gentle curvature leading from the top of the foundations to the trench, suitable for drawing in wire. Inside diameter of pipe to be not less than twice external diameter of cable; least radius of curvature of bend 3 feet. Before and after erection a mandrell of hardwood $\frac{1}{2}$ inch less diameter than the internal diameter of the pipe, and, say, 3 inches long, should be drawn through the pipe to make sure that there are no burrs, fins or other obstructions. If such exist, they must be removed with a steel tube scraper.

Practice varies as to the arrangement of cables in the trench. If this is liable to wet, lead covered cable should be used, supported at intervals of about 15 feet on iron brackets affixed to the wall of the trench. Alternatively, wrought iron pipe may be run along the trench and

ordinary insulated cable drawn in. The method of combining trench work and iron piping is rather expensive. If the trench can be guaranteed dry, ordinary insulated cable can be fixed to the walls of the trench by means of wooden or pot cleats. A trench which is likely to receive water should have its bottom sloped down to the center of the passage, where there should be a gutter with a continuous slope of, say, 1 inch in 10 yards, leading to the station sump or to the drains. If corners are necessary in the trench, these should be rounded off wherever possible, as a sharp bend strains the insulation of a cable injuriously. If it is impossible to remove a sharp corner, a slight amount of slack must be allowed in the cable at the corner. Mechanical joints are not always satisfactory in high tension alternating work, as the slightest slackness causes a dangerous arc. Care should, therefore, be taken to lead the cables to perfectly accessible positions where the terminals are under easy observation, both on the board and machines. This should be observed in the particular case of concentric feeders. It is common practice to bring the station end of the feeder into the middle branch of a T joint box, and there connect it to two separate cables leading to terminals on the board. It is essential that all connections to the joint box should be sweated, and no disconnecting links should be allowed there.

These should be placed in full view either on or at the back of the board.

In continuous current work, where the power is transmitted at a low voltage, the magnitude of the current involves a heavy outlay in copper. To minimize this the runs should be as straight as possible, and the cables should be kept as much to one horizontal plane as convenient. It would be found cheaper, in the case of large outputs, to insert the main machine and feeder switches in the direct horizontal line between bus bars and cables, and to work these switches by mechanical levers and link work from the gallery above, rather than to mount the switches on the board, thereby incurring extra expense in vertical runs. For copper cables inside a station, connecting machines, battery, etc., to board, a current density of 800 amperes per square inch should be adopted; for screwed or coned contacts about 500 amperes per square inch may be allowed, while a density of 400 amperes only should be taken for planed and scraped surfaces bolted together. Leads from regulating cells in a battery room are often made of solid copper bar. A usual plan is to bring these away vertically from the cell terminals to about 8 feet above floor level, thus allowing the attendant a clear gangway all round the cells. The bars are then bent horizontal and passed through holes in a horizontal wood beam running parallel to the line of cells, which is in its turn supported either from ground or ceiling. In this way the rods are held up and prevented from touching each other. Where possible, the rods are led to the wall immediately behind the switch gallery, and are connected either to back terminals on the regulating switch or to a terminal board built into the wall. This is to prevent any gaseous acid escaping into the switch room. Anti-sulphuric enamel is used to cover both the rods and any wood or ironwork in the battery room. Milking leads must, of course, be flexible, and are of ordinary cable. It is found that a grey flintose rubber covering is the best protection for these. Any copper terminals or brass work in the battery room, if not enameled, should be protected by cases having glass fronts and rubber ring joints to exclude the acid spray. Switch gear and instruments should be kept out of the battery room, unless it is absolutely necessary to have them there.

The use of paint as an element of safety is occasionally overlooked by station engineers. In high tension stations, all connections at a high voltage should be painted red. All at a lower voltage—*i. e.*, secondary connections—can with advantage be painted blue. If one side of the high tension system is earthed, the cables on that side should be black. In a low tension, 2-wire station, the negative side should be black, while the positive should be painted red. In a 3 wire station the outers are red, the middle being black.

It is not overstating the case to say that the major portion of the complexity of a station (as far as the electrical part is concerned) is due to a muddled arrangement of connections. It is not enough to have all connections symmetrically arranged at the opening of the station, although this is essential. Sufficient room must be left in the design to allow for extensions. If alterations to plant are decided upon, the scheme of cable connections should be remodeled till the arrangement is simple. A temporary connection should never be allowed, in consideration of weeks of meritorious service, to become permanent. A cable festooned from pillar to post, tied up with bits of rope, is a sight more common than comely. An engineer who does not keep his cable connections simple and up to-date should insist on his wireman taking out an insurance policy.

The Development of Power at Niagara Falls.[1]

A very important and thoroughly interesting paper on the history of the earliest development of power known to have been made at Niagara Falls has been prepared by Arthur Schoelkopf, who is at the head of the Niagara Falls Hydraulic Power & Mfg. Company, owners of the hydraulic canal power, which is the oldest development at the Falls.

In this paper Mr. Schoelkopf has pointed out how the Company are now operating their central station under a head of water which a few years ago it was thought impossible to use, because of the apparent inability to build wheels that would withstand the strains of such a head. The Niagara Falls Hydraulic Power & Mfg. Company are now operating their turbines under a head of 210 feet, and in what Mr. Schoelkopff has said, he not only has told all about the Niagara development, but he has incidentally and indirectly outlined in an exceedingly plain way, by the object lesson presented by his Company's development, the wonderful progress that makers of turbines have made in the past 20 years in meeting the requirements of just such wonderful developments and projects as those at Niagara Falls.

It has been the ambition of the engineers and laymen from the time Niagara Falls was discovered to utilize its vast energy for power purposes. The first occasion which we learn of any part of the water power of the Niagara being put to practical use is in the year 1750, when French settlers built a small saw mill on the river bank, opposite Goat Island. History does not inform us in just what manner the power was utilized, but undoubtedly their machinery was of the most primitive description. Again, In 1810, D. Clinton, and, in 1825, Lafayette, utilized some of this power. From this time, as the wants of the increasing population made it necessary, other mills and manufacturing establishments were erected on a small scale. It remained for Gen. Peter B. Porter and Augustus Porter, in 1840, to devise a practical plan of development. Gen. Peter B. Porter died in 1844, and in 1847 Augustus Porter issued a circular describing a plan practically the same as that now being carried out by the Niagara Falls Hydraulic Power & Mfg. Company.

The grounds of this canal were donated by the heirs of the late Hon. Augustus S. Porter and Gen. Peter B. Porter, in 1852. Negotiations were commenced with Caleb J. Woodhull and Walter Bryant, and an agreement was finally reached with these gentlemen by which they were to construct the canal. They received a plot of land at the head of the canal having a frontage on the upper river of about 600 feet, and a right of way 100 feet wide for a canal along its entire length of 4,400 feet, which now is through the most thickly populated part of the city. They were also given about 75 acres of land near its terminus, having a frontage on the river below the Falls of nearly a mile.

In March, 1853, the Niagara Falls Hydraulic Company was incorporated, with Caleb J. Woodhull as President and Walter Bryant as Agent. This Company at once made a contract for the construction of a canal 70 feet wide and 10 feet deep, with wharves at its connection with the river. Work seems to have been begun promptly and carried on for about 16 months. It was then suspended for lack of funds until 1858, when it was carried on for a time by the Niagara Falls Water Power Company, Stephen M. Allen, President. A short time afterward Horace H. Day acquired the property, and July 1, 1861, completed a canal 36 feet wide and about 8 feet deep. The war of the rebellion broke out at this time, followed by years of business depression. No use was made of the canal until 1870, when Charles B. Gaskill built a small grist mill on the site of the present flouring mill belonging to the Cataract Milling Company, of which Mr. Gaskill was President.

In 1877 the canal and all its appurtenances were purchased by Jacob F. Schoelkopf, of Buffalo, and Abram Chesbrough, of La Salle, N.Y., who organized the Niagara Falls Hydraulic Power and Mfg. Company, of which Mr. Schoelkopf was President up to the time of his death, September 15, 1899, and Arthur Schoelkopf, Secretary and Treasurer. Since that time the enlarging of the canal and the development of electrical and hydraulic power has gone steadily forward, mainly through the indomitable energy of Jacob F. Schoelkopf and his great faith in the future of this great water power and the location of Niagara Falls up to the time of his death.

The mills of Schoelkopf & Mathews, Cataract Milling Company, Central Milling Company, Pettebone-Cataract Paper Company, the City Water Works and the Niagara Wood Paper Company leased the right to draw a certain quantity of water from the canal, construct their own wheel pits and install their own water wheels.

Two different methods were adopted for constructing the pits for

1. *Iron Age.*

these various mills. In some cases shafts were sunk into the rock back from the edge of the bank, in which the wheels were placed, and a tunnel driven from the bottom of the shaft to the face of the bank for a discharge of the water after it had passed through the wheels. In other cases a slot was cut in the face of the bank, in which wheels were placed. In all cases turbine wheels of different make running on vertical axes were used.

In 1881 the Niagara Falls Hydraulic Power & Mfg. Company installed their first plant for the purpose of supplying power to customers, the power to be delivered mechanically at their mills. The method adopted was as follows: A shaft 20 by 40 feet and 80 feet deep was sunk 200 feet back from the face of the high bank, and from this shaft a tunnel was driven to the face of the bank from a tail race. The water was conducted to the bottom of this shaft in iron penstocks and used on two different turbines running on vertical axes, from which the power was transmitted to the different factories.

Mr. Porter's contract with Messrs. Woodhull and Bryant only conveyed the land to the edge of the high bank and did not include the talus or slope between the edge of the high bank and river, and only granted the right to excavate down to the face of the bank 100 feet. At that time it was not considered that higher heads would ever be utilized, as it was deemed unwise to construct water wheels to stand a pressure of a higher head, and, in fact, none of the mills attempted to utilize more than 50 or 60 feet.

Hydraulic engineering advanced so rapidly in the early '80s that the Niagara Falls Hydraulic Power & Mfg. Company, in 1886, secured a deed of portions of the slope between the high bank and the river, having since secured other portions, so that at the present time they are at liberty to use this slope for power purposes under a head of head of water of 210 feet. A part of this slope was leased to the Cliff Paper Company in 1892, who built a pulp mill at the water's edge of the lower river, developing 2,500-horse power under 120 feet head by using the water discharged from the wheels in the pits constructed by the Hydraulic Power Company in 1881. In 1886 Wallace C. Johnson was appointed chief engineer and has had charge of the engineering work since that time.

The canal as completed by Mr. Day had a capacity of 15,000-horse power under 100 feet head, but as the water had been used under less heads, its capacity was exhausted in 1892, and only about 7,000-horse power produced. The demand for power increasing, the Niagara Falls Hydraulic Power & Mfg. Company found it necessary to commence an enlargement of their canal, and have continued improving the same up to the present time, which, in 1900, had a capacity of 36,000-horse power under the full head of 210 feet.

The water for the plant is led from the hydraulic basin in two open canals or flumes to the forebay, 30 feet wide and 22 feet deep, built near the edge of the high bank. From this forebay the water is conducted to the power house by means of three penstock pipes, one of them being 8 feet and the other two 11 feet in diameter, built of flange steel. This plant, with a working capacity of 30,000-horse power, is nearly completed. It consists of 14 turbine wheels, from 2,000 to 3,000-horse power each, mounted on horizontal axes, with direct current generators coupled to each end. From these generators the current is conducted to the top of the bank by means of wires and bars, in wire towers, built alongside of the penstocks, and thence in underground subways to the various consumers.

The tenants of this Company and their manufactured product are as follows:

The Pittsburgh Reduction Company.—Aluminum; now using 6,600-horse power, contracted for 4,000-horse power, total 10,600-horse power.

The National Electrolytic Company.—Chlorate of potash; now using 2,200-horse power.

Alloy Smelting Company.—Ferro chrome and other alloys; now using 400-horse power.

Acker Process Company.—Bleaching powder and caustic soda; 3,200 horse power.

B. & N. F. Electric Light & Power Company.—Arc and incandescent lighting; now using 400-horse power, contracted for 650-horse power, total 1,050-horse power.

Niagara Silver Company.—Silver ware; 125 horse power.

Niagara Gorge Railroad Company.—350-horse power.

Lewiston & Youngstown Electric Railroad.—100-horse power.

Niagara Falls Brewing Company.—86-horse power.

Cataract Hair Cloth Company.—Hair cloth; 16-horse power.

Niagara Frontier Electrical Machine Company.—10-horse power.

Niagara University.—For electric lighting, etc.; 30 horse power.

New York State Reservation.—For lighting; 20 horse power.

Sundry small consumers, 150-horse power.

Total amount of electric power, 19,037-horse power.

Mechanical Power.—Carter Crume Company.—Check book factory; 60 horse power.

Oneida Community, Limited.—Silver plated wares; 300-horse power.

Total mechanical power, 360-horse power.

Hydraulic Power.—Cliff Paper Company.—Paper and wood pulp; 2,900 horse power.

Niagara Wood Paper Company.—Wood pulp; 250 horse power.

City of Niagara Falls Water Works.—150-horse power.

Niagara Falls Milling Company.—Niagara mill, flour and feed, 900 horse power; Central mill, flour and feed, 1,000 horse power; total, 1,900 horse power.

Pettebone-Cataract Paper Company.—Paper and wood pulp; 1,400-horse power.

Cataract City Milling Company.—Flour and feed; 400-horse power.

Total hydraulic power, 7,000-horse power.

The Niagara Falls Hydraulic Power & Mfg. Company are capitalized at $500,000, and their officers are George B. Mathews, Buffalo, President; W. D. Olmstead, Buffalo, Vice-President; Arthur Schoelkopf, Secretary and Treasurer; D. P. Jones, Chief Engineer, and Wallace C. Johnson, Consulting Engineer, John L. Romer, of Buffalo and J. F. Schoelkopf, Jr., with the above named officers, constitute the Board of Directors.

Mr. Pliny Norcross on Municipal Ownership of Electric Lighting Plants.

At the last annual meeting of the Northwestern Electrical Association (Milwaukee, Jan. 16 and 17), the address of the President (Mr. Pliny Norcross) contained a lengthy mention respecting municipal ownership of electric lighting plants. His presentation of that subject was as follows:

The Fourteenth Annual Report of the Commissioners of Labor includes data from 952 plants in the United States, of which 320 are owned by municipalities, while 632 are operated under private or corporate ownership. Neither the names nor locations of these plants are given, but each plant is reported by a certain number. The report itself includes about 1,000 pages of carefully prepared matter, and was suggested by a committee of the National Association of Officials of Bureaus of Labor Statistics in the United States, consisting of Mr. Lee Merriweather, Commissioner of Labor of Missouri; Mr. Horace G. Wadlin, Chief of the Bureau of Statistics of Labor of Massachusetts, and the president of the Convention—the United States Commissioner of Labor.

A study of this report develops many interesting facts. In one municipal plant, No. 151, there were 8 private arc lamps, 1,200-candle power, and 10 public street lamps. The users of the 8 private arc lamps were obliged to pay the city 12 cents a kw-hour, while the city paid nothing for its 10 street lamps. In other words, a few enterprising citizens paid for their own light 5 or 6 times as much as they would have paid to a private company, and they alone, thereby, carried the burden of lighting the streets, which should have been borne by all of the taxpayers.

In No. 152 the private user was compelled to pay 6 cents per kw-hour for 8 arc lamps, and $1 apiece for 2 other lamps, while the city reports that for its 26 arc lamps it pays but 2½ cents a kw-hour. In No. 156 it costs the city 5¼ cents a kw-hour for 42 street arc lamps. In this town or city there seems to be no private user willing to bear the burden of lighting the city.

In No. 160 it costs the city over 12½ cents a kw-hour to light 75 street lamps. In No. 161 a private company furnishes the city and private users light at the uniform and moderate price of 2½ cents a kw-hour. In No. 163, 15 private arc lamp users pay the city plant a little over 9 cents a kw-hour, and thus enjoy the honor of supplying the city with 14 street lamps free of cost to all other residents. In No. 165 there seem to be no public spirited citizens who take arc lamps, and thus the cost to the city is over 3 cents a kw-hour. In No. 167 the city owns and operates the plant and furnishes arc lamps to 17 private users at 4½ cents, and admits a cost to itself for 50 arc lamps of over 11$\frac{5}{16}$ cents per kw-hour. It is barely possible that the private users are public officers.

In No. 168 a private company gets between 8 cents and 12 cents from private users and receives from the city about 8½ cents. In No. 174 a municipal plant furnishes incandescent lamps for 8 cents a kw-hour, and thereby gets its own lamps for nothing. In No. 175 the same

policy is pursued by a municipality, the private users alone paying for city lighting. In No. 179 the city furnishes 1,050 incandescent lamps for 10 cents a kw-hour, and thereby gets its 24 arc lamps for a trifle less than 1 cent a kw hour.

In Nos. 187 and 188 it costs the city $ 0461 and $ 0347, respectively. No private users. These samples are taken from 1 or 2 pages as they run.

The book, or report, is very interesting, and it establishes the fact that a city is not as well equipped to perform the intricate work of making and selling electric current as a private company which makes this class of work a close, careful study, for the sole purpose of furnishing to all customers reliable light, or power, or both, at a fair price, and at a very small profit to itself.

In cases of municipal ownership the city pays no direct tax on its plant, but indirectly it does pay a tax, because it does not receive the tax which a private company would pay into the treasury.

Ordinarily, a municipal plant makes no allowance for depreciation or for the exchange of improved appliances for the old system.

A city cannot buy material any cheaper than a private company, and usually not so cheaply; generally it pays more wages for inferior service. It is handicapped in the matter of adopting improvements.

In the matter of personal damage suits, a city occupies an unfortunate position. A city is not so well situated for speedy recovery from damage by freshets, cyclones or fire, as a private company.

Not long ago a Texas city gave bonds for over $1,500,000 for the construction of an immense dam and power plant, in the belief and hope that it could not only light its streets and public buildings for nothing by selling current to private consumers, but could secure a large profit thereby. It is a matter of record that the dam when built would not hold water, and utterly failed to furnish power for the use of the city alone. The enormous burden thus placed upon the city has reduced the price of real estate and discouraged investment.

Numerous instances can be readily cited to sustain the proposition that although the theory of municipal ownership is very bright and full of promise, yet the actual practice as shown by the majority of cases is not encouraging. Aside from figures and details, there is, to my mind, one insurmountable obstacle to city ownership and continued successful operation of electric plants:

All city officers must be elected by the people at large; as a rule, they never have been, and probably never will be elected for their fitness to discharge the various duties which they so willingly assume.

I readily concede that in many instances they are intelligent, honest, public spirited men, and if they could remain in office long enough, and could afford to give up their own business and would devote their energy and time to the city business, they would soon become competent to perform the duties incident to their positions.

The whole matter of streets, sidewalks, gutters, sewers, parks, bridges, pavements, schools, courts, police, sanitary regulations, water and light supply, etc., is in most instances entirely new to them.

They are nominated and elected by their friends, and when elected they must take care of their friends, and that fact alone prevents such a discharge of their duties as they themselves would desire; but outside of those who are honest and intelligent, a great many are nominated for the sole reason that they can be elected when nominated. The same clique or "pull" which nominated them, also elects them. There is no pretense that they are capable, and there is no thought or care as to their honesty. If their record is a little shaky on that score, all the better for the purpose of those who secured their election.

When elected they must help their friends; but whether honest or dishonest, capable or incapable, most of them have had no experience in the work which comes to them when once in office. Their terms of office are short and uncertain; they generally receive no pay for their work; they are blamed and abused by the press or a part of it, and by a good part of those who elected them, and by all who opposed them. No sensible business man would for one week trust his business to such control or management.

The "fad" of municipal ownership of electric plants may sweep over the country as other socialistic, communistic, impracticable schemes have done, but it will in the end be a ruinous experience, and I firmly believe that there is not now so strong a sentiment in its favor as there was a year ago.

As the matter of municipal ownership is more fully understood, the desire for it will diminish. One reason for its adoption by many towns is the fact that unpleasant relations have grown up between the local plant and the municipality. The citizens are possessed with the idea that the local company is making too much money out of the business, while the company is confronted with the fact that the original outlay was not always a judicious one, and in all cases was very expensive.

I well remember the time when carbons, dynamos, lamps, etc., cost three times as much as they do now. In every case the original plant was too small, and people who first invested were glad enough to get out of it at any sacrifice. Most of the plants in operation to-day stand upon the ruins of one or two earlier plants.

The competing gas companies at first were somewhat disturbed by the new illuminant, and cut prices in order to hold their plants in operation. New electrical inventions then, as well as now, have compelled the abandonment of the earlier equipment.

Cities are besieged with applications, for apparently better contracts, and too often forced the old companies which had struggled bravely to hold up against the rising tide, into bankruptcy. The city often gave franchises to new companies, or still worse, practically confiscated the existing plant by putting in one of its own. In this way many of the pioneer plants proved to be unfortunate investments. Most of these unfortunate facts could have been prevented by a little mutual concession.

We are now called up in the matter of taxation. Many persons believe that none of the existing corporations are paying their proper proportion of the public expense. We cannot speak for others, but we believe that electric corporations are paying more than their share. The city insists upon getting the very lowest figure for its own service, in streets and public buildings, under the threat of municipal ownership, or, of permitting outside competitors to sweep away the local investment—then, after getting the very lowest figure, proceeds deliberately to give the local electric company another twist, by raising the taxes from 50 to 100 per cent.

I sincerely believe that all of this unpleasant condition could be very much improved, if the State and municipality would adopt a new method of procedure. Instead of treating us as enemies to the public welfare, we should be treated as men who are engaged in the laudable effort of endeavoring to promote and enlarge one of the most useful industries known in the history of civilization. Treat us fairly, remember that the road which we have traveled for the last 15 years is literally strewn with the wrecks of hundreds of failures.

Almost all other corporations, such as railroads, telegraphs, telephone companies, water companies, gas companies, have passed through the trying years of experiment and disaster, and are now standing on firm financial grounds. Their bonds are listed in all the market quotations of the world, and their stocks have a definite value; while our stocks and bonds are, in the main, unquoted and unsalable.

I would suggest as one way of reaching a better and fairer understanding between the local companies and the municipalities and States, that we promptly and honestly open our books to the inspection of the new Board of Taxation in this State, or to an inspector of that board, if such an officer should be appointed in that board, as recommended by our present Governor, in his recent address to our Legislature. Such action on our part would certainly give us the right to ask that our taxes should bear a proper relation to the salable value of our plants, and to our net earnings, and would in a large degree settle the question of whether or not the price of our product was reasonable, and would have a tendency to satisfy our own customers, including the cities where we individually operate, that we were treating them fairly. It would further give us the right to insist that the present Board of Tax Commissioners should not name a percentage or license fee at any arbitrary figure, until the Commission has fully examined the facts in each case.

Fifteen years ago an electric plant was considered an experimental, dangerous luxury. To-day it is an established fact that such a plant is one of the most necessary, useful and practical equipments of any city, town or village. It furnishes not only a cheap, safe and healthful light, which, of itself, is a most valuable assistant in preventing crime and securing good order, but it furnishes power at a low price for the local grain elevator, or grist mill, creamery, factory, woodyard or water tank, as well as for the dentist, blacksmith or sewing girl. It will cool the dwelling, office or hotel in summer time, and when connected with the hot water or steam system, it will heat the same in winter.

It puts the town or village in close companionship with the adjacent city by means of the suburban road. It is utilizing every water power on the face of the globe, thereby adding millions of horse power which since the creation has remained dormant. Instead of being opposed in its onward march and made the victim of unreasonable competition and of constantly increased taxation, it should be encouraged and sustained.

The practice of confiscating such a plant, or compelling it to produce

current at less than cost, and continually and persistently raising its tax, makes it a precarious business and prevents improvement.

The matter of depreciation (which with us is a very serious one), the price of fuel and the freight thereon, vary almost 100 per cent. in different parts of the Northwestern States; the price charged for our products, the wages paid, etc., tend to make the gross earnings of an electric plant an unjust standard of assessment. Yet, it may be the only method to adopt.

I would suggest further that the Board of Tax Commissioners recommend a sample of uniform books for our business. Then, after we have fairly done our part, in the matter of furnishing to all our patrons good light and reliable power, we want the State as well as the municipality, to stand by us and not confiscate our property or ruin us by unjust competition. Competition cannot reduce cost; it takes from the poor and weak, and gives to the rich and strong. No city or State should use it as a club to ruin its own citizens or taxpayers.

We must eventually pay our bonds, and our stock ought to be worth par. We must pay interest on our bonds, and we should be able to pay fair dividends on our stock. We must allow more for depreciation than any other of the public industries, and we should be allowed to put aside a reasonable surplus for disaster and for the replacement of present equipment for improved equipment.

If the State and municipality would be fair toward us, we should in a short time possess electric industries which would combine the superior attention, care, economy and experience of the private company, with public inspection and oversight, which, in my judgment, would be an almost perfect system. It would secure fair prices, good products, and would be a bulwark against failure or bankruptcy.

h Rate Question.

[A paper read by MR. HENRY L. DOHERTY, at the last meeting of the Northwestern Electrical Association.]

At the last meeting of the National Electric Light Association, I read a paper entitled "Equitable, Uniform and Competitive Rates." I proposed a rather radical departure from our present methods, which seemed to me a logical solution of many of the difficulties which now confront us. Before adopting a rate system differing radically from all methods with which I was acquainted, I wished to obtain an expression of opinion from representative central station men which I thought would prove my plan either meritorious or otherwise. The discussion this paper provoked was not general, and no valuable points were developed. The sentiment at the meeting was unfavorable to the plan I outlined. The paper received but little comment from the electrical press, and was read in full only by those who chanced to obtain an advance copy published for the meeting. Since the Chicago Convention to the present date I have been kept busy answering correspondence regarding this rate system, and few of my correspondents seem to have gained from my paper a clear understanding of my views. The plan I then outlined seems to have grown greatly in favor, and many of its early and most pronounced opponents now express themselves as believing that it offers the best solution yet proposed towards the establishment of equitable and uniform rates.

After reading my former paper, I found it a hardship to answer all of the correspondence received, owing to the fact that many inquiries were made without having carefully read and considered my paper To have answered some of them fully would have necessitated a repetition of much that had already appeared in printed form. I cannot attempt another exhaustive treatise on this subject, but if anyone is sufficiently interested in this matter to carefully read this paper, and also my former paper, which will be found in the published proceedings of the last convention of the National Electric Light Association, I will not only willingly answer any inquiries they care to make, but will welcome any discussion of the subject by correspondence.

There are really but two distinct methods of charging for electric service, viz.: First, flat rates; second, meter rates.

An analysis of flat rates would mean a definite charge for a fixed capacity, regardless of quantity of current used, within a limit of no use to constant use. This would work out to a minimum kilowatt rate, for current of the fixed rate, divided by the maximum consumption, to a maximum kilowatt rate, to infinity, if no current were used.

An analysis of meter rates would mean a fixed charge per unit of current sold, regardless of capacity demanded. In this case the station's cost to procuce would vary from the very low cost per kilowatt hour, if total capacity were used continuously to infinity, if no current were used. In the abstract, flat rates are preferable, as they give the station the advantage of the infinity end of the variation, but both systems seem to me almost absurd.

Theoretically, flat rates can be placed sufficiently high to absolutely protect the station from loss, but such rates would drive away much profitable business.

Meter rates cannot be placed so high but that loss may result. Even if a consumer agree to pay $1 a kilowatt his consumption may be so small that his total payment will not equal the cost of reading his meter, keeping books for his account, core loss of transformer capacity and shunt loss of meter.

It is probably unnecessary to comment on the inequity of flat rates, but rates based solely on consumption, without considering the maximum demand that the station must be prepared to supply, are often even more inequitable. An analysis of the accounts of one central station, with which I am familiar, will illustrate the relative worth of different consumers supplied on a meter basis. A minimum bill of $1 per month is now charged if no current is used. This means a minimum of $1 per lamp per month, if the consumer has but one lamp, and 001 per lamp per month if the consumer has 1,000 lamps. At this particular station—

The average yearly bill is $1.96 per lamp.
The minimum yearly bill is .24 " "
The maximum yearly bill is 38.46 " "

Assuming that the station represents an investment of $20 per lamp wired up, this means that for these different classes of consumers, were all the consumers of one particular class, the lengths of time for our gross revenues to equal our investment—

For the average consumer 10 years and 2 months.
For the minimum consumer 83 years and 4 months.
For the maximum consumer no years and 6 months.

If the entire amount paid by the minimum consumer were clear profit, you would be earning but 1.4 per cent on your investment. The consumer using the least current, may add just as much to your absolute maximum demand as any other consumers you have. I once cited the case of a church, which is generously equipped with lights, but which for several years past has used light but one night each year, and that night is Christmas Eve, or the preceding night.

Charging a fixed rate per kilowatt hour on a meter basis bears no relation to cost of service. Cases may sometimes be best illustrated by exaggerations. Suppose you should receive an application for a 2,000 light connection to be used as a relay in case of a breakdown of an isolated plant. At what rate per kilowatt could you afford to supply the applicant with current? This is the same problem which confronts us on a modified scale with each consumer.

Our costs are fixed by:

1. The number of consumers we have.
2. Distance from the station.
3. Capacity they demand.
4. Amount of their consumption.

Distance from the station is influenced by where we locate our stations, and I see no reason why we should vary the cost to different consumers because of varying distance from the station, except in extreme cases. For lack of time I will drop this item of cost from further consideration and go to the others.

There are certain costs, such as bill making and meter reading, which are entirely fixed by the number of consumers or meters, and many of our other costs are virtually fixed by the number of consumers or meters we must care for, such as meter testing and maintenance, rent, complaints and gratuitous work, superintendence and inspection. To cover such expenses as these I propose to have a fixed charge for each consumer, regardless of his consumption or the size of his installation, provided no more than one meter is installed.

There are certain other costs which are fixed by the capacity demanded, such as interest on investment, transformer losses, maintenance, depreciation, etc. To cover such expenses as these I propose to have a fixed charge for each lamp the consumer's connection will permit him to demand, without regard to the number of lamps installed or amount of current used.

There are other charges which are fixed by the quantity of current generated, such as boiler fuel, lamp renewals, etc. To cover such expenses as these, I propose to charge a fixed and uniform rate per kilowatt hour consumed.

A moment's consideration will, I think, convince all of you that outside of boiler fuel and lamp renewals your operating costs would not be greatly increased if you operated 24 hours per day at your maximum load, nor would they be greatly diminished if you operated but 5 minutes per day at your minimum load, assuming, of course,

that you stood ready to serve current at any time throughout the 24 hours should it be called for.

A charge for "readiness to serve" fixed on this basis, and a low kilowatt hour rate, will bring about many advantages to the central stations and protect them from loss, unprofitable patronage, and, I believe, will also protect them from undesirable legislation.

I recognize the fact that any change in methods of charging will cause trouble, if enforced suddenly on those consumers whose bills it will increase, but this system can be used in place of horizontal reductions in the rate now charged, and can reasonably be exacted from new consumers, and eventually made universal. Evolution—not revolution—must be the policy of all quasi-public corporations. In view of the fact that it will be inadvisable to enforce this system on old consumers who will be injured by its adoption, I propose to adopt it first as a substitute for all special rate consumers, and also for new consumers. Instead of dividing my expenses as they exist to-day and apportioning them amongst the consumers on this basis, I expect to adopt such charges as will benefit long hour, and therefore profitable, consumers to such an extent as can be readily compensated for by the additional business which can be secured with a lower rate per kilowatt hour. I will continue the rate cutting by small steps so long as I can protect the company's net earnings from marked shrinkage.

In one station where we have been experimenting we are convinced that it is profitable to supply consumers on this rate system, making a fixed charge of $6 per consumer per year, plus $1.80 per lamp demanded per year, to which is added 4 cents per kilowatt hour for current used, than to sell at a straight rate at 10 cents per kilowatt hour. It is needless to call attention to the fact that consumers will be much more liberal in the use of current when supplied at 4 cents than at 10 cents per kilowatt hour. My plan is to make all contracts for a year or more, allowing the consumer to contract for any capacity he may choose, the capacity to be increased whenever he desires, but not to be decreased except at the expiration of the period contracted for; the capacity to be limited by a suitable maximum demand cut out to prevent him from demanding more capacity than he contracts and pays for, and one twelfth of the fixed charge to be included in each monthly bill.

The system, I believe, can be absolutely uniform, both for light and power, and will prove more equitable than any other system.

A reduction of the kilowatt rate should be made for current supplied for power purposes to compensate for higher costs of lighting service, owing to the exact degree of regulation necessary and the cost of lamp renewals, which is a more important item than is generally believed.

I have no patents or copyrights on this system or the appliances its use demands. Anybody can use it as described or as they care to modify it.

This system is already in use in one central station with which I am connected, and we are about to put it in use in two others. It has also been partially adopted by other central stations with which I have no connection and for which I have no authority to speak.

The New Texas Oil Fields.[1]

The oil production of Texas, which has been increasing for some years past, has heretofore been confined to the Corsicana field, and to a small field in the neighborhood of the old town of Nacogdoches. The new discovery recently made in the southeastern section of the State, not far from the town of Beaumont, promises to open up a new field of much importance. Some prospecting has been done in this section in previous years, but with no positive results.

Some two years ago Capt. A. F. Lucas, who was at one time connected with the Avery Island, Jefferson and other salt properties in Louisiana, began to prospect for petroleum in the neighborhood of Beaumont. He obtained oil leases on lands at Gladys City and other points, but did not meet with success. Finally he leased, several months ago, the rights on a tract of 5,000 acres belonging to the McFaddin-Wiess Kyle Land Company, on which the new well is located. Messrs. J. M. Guffy and John H. Galey, of Pittsburg, were associated with Captain Lucas in the enterprise, and Hamill Brothers, of Corsicana, Texas, experienced borers, were engaged to sink the well.

The surface of the tract where the operations were conducted is marshy and level prairie, fit only for rice cultivation. The country rock is undoubtedly of recent Quaternary formation. Much difficulty was experienced in sinking through the water-bearing surface soils, but Captain Lucas finally adopted the system used by him in boring for salt in Louisiana, and described in a paper written by him for the American Institute of Mining Engineers. An abstract of this paper was publisbed in the *Engineering and Mining Journal*, November 11th, 1899, page 577. The casings used were heavy and were in succession 12-inch, 10-inch, 8-inch, 6-inch and 4-inch, each smaller pipe telescoping with the one above it. The lower or boring pipe, fitted with a cutting edge, was driven downward with a constantly revolving motion, while water was forced through by means of a circulating pump. In this way the borers were enabled to cope with the immense bed of quicksand, which had deflected the previous attempts—made in 1894, in 1896 and in 1898—to prospect for oil in the same locality.

At a depth of 1,300 feet oil was struck suddenly and almost without warning. The 4-inch pipe in use, which weighed at least 6 tons, was forced to the surface by the sudden flow of oil, carried through the top of the derrick—which is 60 feet high—and thrown up in the air a distance estimated at 300 feet. The tackle and the top of the derrick were carried away, while the pipe bent and curled up, falling to the ground clear of the derrick in a position where, fortunately, it injured no one. The water in the pipe, which was used in the hydraulic boring, was thrown up to a great height, followed by some gas and a steady stream of oil. This flowed with such force that large pieces of rock were carried up with it. The first flow was estimated at 250 barrels an hour; it increased gradually to 500 barrels, and on January 13th was estimated at from 600 to 1,000 barrels an hour, with the flow still increasing. At times the column reached a height of nearly 600 feet, and some observers, among whom were some employees of the Standard Oil Company, were inclined to think Captain Lucas too conservative, and to put the flow as high as 2,000 barrels an hour.

The flow is at present entirely beyond control. Much oil, however, has been saved by running it into a natural depression of the ground near by, which covered nearly 50 acres, while the force of 300 men and 50 teams has been at work building levees and excavating reservoirs in which oil can be temporarily stored. As soon as possible tanks will be built and arrangements made to dispose of the oil. It will be a comparatively easy matter to build a pipe line to Beaumont or Sabine Pass, whence oil can be shipped either by rail or water. In fact, there is no other oil district known in the United States where shipments to a market can be arraaged so easily.

Hasty chemical examinations show that the oil is a light oil, having a paraffine base and containing some sulphur. It is believed that it will give a good percentage of illuminating oil; and it is of better quality than the Corsicana oil.

Naturally this strike has attracted much attention. People are flocking to the district, and oil leases on neighboring lands are in great demand. Other explorations, however, were already in progress. Mr. J. A. Paulhamus has been for some time engaged in putting down two wells near Taylor's Bayou in Jefferson County. The Sabine Oil and Pipe Line Company is putting up a rig 8 miles north of Beaumont. Many others will doubtless follow.

Credit is due Captain Lucas for his perseverance in prospecting, and for his ingenious adaptation of methods to the peculiar conditions of Southeastern Texas.

1. *Engineering and Mining Journal.*

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT the annual meeting of the Columbus (Ohio) Board of Trade, Mr. Irvin Butterworth, President and General Manager of the Columbus Gas Company, was elected President for the ensuing year.

AT the annual meeting of the City Gas Company, of Portsmouth, Va., the Directors chosen were: Peter Wright, W. H. White, R. Lancaster Williams, F. R. Pemberton, J. D. McIlhenny, H. Hodges, J. G. Womble, H. L. Rice, J. W. Middendorf and M. T. Cooke.

A CORRESPONDENT at Nelson, B. C., forwards the following: "Manager Burnett, of the Nelson Gas and Coke Company, is well satisfied with the business done by his Company during 1900, and is sure of a large increase during this year. The Company expended $100,000 before receiving any return. The owners of the Company took chances, and their investment is proving a profitable one. The number of users of gas is steadily increasing, and there is a ready sale for all the coke made at a price that yielded good profit. The Company's payroll aggregates several thousand dollars a year, all of which is spent in Nelson. One of the industries the Company intended engaging in on a large scale was the manufacture of coke, and Manager Burnett is still in hopes that the Directors will authorize the work to be done at an early date."

THE Norwich (N. Y.) *Union* says that Messrs. S. N. Blake, of Elmira, N. Y., and E. F. Kizer and E. L. Smith, of Towanda, Pa., have made a contract for the purchase of the gas and electric light plants of Norwich, and will take possession of the same at once. The reorganized concerns are to be known hereafter as the Norwich Gas and Electric Company.

THE New York Central and Hudson River Railroad Company has contracted with the American Bridge Company for 2 drawbridges, which are to be operated by gasoline engines, one of them to be located near New Hamburg, N. Y., and the other one near Little Ferry, N. J. Both are to be through plate girder bridges with double track.

MR. B. S BERLIN is named as the probable successor to the late Mr. James Gilbert as gas inspector for Omaha, Neb.

THE proprietors of the Media (Pa.) Gas Light Company are contemplating the extension of the mains to the adjoining boroughs of Upper Providence and Nether Providence.

AT a meeting of the shareholders in the Siemens-Lungren Gas Lamp Company, of Baltimore, Md., it was voted to wind up its affairs. The reason given for the liquidation is that "there is no longer a demand for its lamps."

THE Brooklyn (N. Y.) *Times*, dated January 20th, states that on the date named, Ernest Wallace, acting as counsel to Mr. A. L. Fennessy, of New York city, sent in a communication to the Village Board of Trustees of Freeport, L I., withdrawing his application for a franchise to operate a gas works in Freeport.

AT the annual meeting of the Evansville (Ind.) Gas and Electric Light Company, the following Directors were elected: Francis J. Reitz, R. K. Dunkerson, T. E. Garvin, Jacob Eichel, John Gilbert, Sebastian Heunch and Jas. L. Orr.

W. B. HERTER is informed that Mr. Charles H. McKee, of Pittsburg, Pa., was the main factor in the recent purchase of the named properties at Hot Springs, Ark.—the Hot Springs Electric Light and Gas Company and the Hot Springs Water Company. We also understand that Messrs. S. W. Fordyce and Albert Gaines are concerned with Mr. McKee in the purchase.

THE Bangor (Me.) Company proposes to extend its pipes to the outlying village of Bremen.

MR. M. E. NEARY, assistant inspector of gas, Minneapolis, Minn., was recently dismissed. His offense to the ruling powers was that he is a Democrat. His successor is Mr. Edward Chase, who, under the circumstances it is needless to add, is a Republican. Mr. Neary was in every sense competent to carry out the duties of the post from which he was removed.

A PETITION is before the General Assembly of Connecticut for the incorporation of the Groton Gas Company.

AT the annual meeting of the St. Paul (Minn.) Gas Light Company the officers chosen were: Directors, A. P. Lathrop, A. E. Young, M. Auerbach, Crawford Livingston, Emerson McMillin and F. W. M. Cutcheon; President and General Manager, A. P. Lathrop; Vice-President, F.W. M. Cutcheon; Secretary and Treasurer, J. P. Crowley.

AT a meeting of the Town Board of Cicero, Ills., an amendment to the ordinance of the Cicero Gas Company was adopted. Under it the franchise of the Company is extended for a further period of 15 years, in consideration of which it agrees to charge not in excess of $1.10 per 1,000 cubic feet to ordinary consumers, and pledges itself to lay 20,000 feet of distributing mains in Cicero, south of West 12th street, within the next 9 months.

"R. S., writing from San Francisco, Cal., under date of Jan. 23d, says: "Last week Assemblyman Frank James, of Los Angeles, introduced to the State Assembly a bill, bearing the number 353. He says it is designed to prevent discrimination in respect to rates that may be charged to users of gas and of electric lighting currents. The measure is in the nature of a grant of additional authority to the City Council or governing body of a city extending its power, from the simple fixing of the maximum rate to the prevention of lowering that rate in favor of certain consumers unless the reduction is made general. The bill stipulates that uniform rates must prevail where the cost of the service in furnishing water, gas or electric light is the same. A reasonable difference in the rate is permissible where inaccessibility or other conditions increase the cost of service. The granting of rebates is forbidden, and the author of the bill hopes to perfect it to the degree that discrimination by such methods can be prevented. He will probably add two important sections to the measure before it comes from the Committee on Municipal Corporations. One will make the power on regulation extend to the furnishing of electric power. The other will provide, within reasonable limits, that a rate once established must be maintained by a water, gas or electric company, the object being to prevent recourse to destructive competition against a new company by a well established one that seeks to drive its rival out of business. I may add on personal account and belief that the bill will not pass. And I might further add that if it does it will never be sustained, even under the tenets of our peculiarly framed State Constitution."

THERE is some opposition to the petition of the Beverly (Mass.) Gas and Electric Company for permission to extend its mains and lines to the adjoining districts of Manchester, Wenham and Hamilton. The complaint seems to lodge in Manchester, the "rulers" of which hope some day to have the conducting of a municipal plant.

MR. S. P. CURTIS has assumed his duties in connection with the main office of the American Gas Company, of Philadelphia. He succeeds Mr. R. B. Brown.

UNDER its operation of the Philadelphia City Gas Works, the United Gas Improvement Company, under the terms of the agreement, has turned over to Controller Walton the sum of $95,746.80, as the municipality's share of the profits for the quarter ended December 31, 1900. For the corresponding quarter of 1899, the payment was virtually $10,000 less.

MAYOR HINCHLIFFE'S veto of the ordinance, recently passed by the Paterson Board of Aldermen, which purported to give corporate life to the North Jersey Gas Company, under which it might "lay, keep and maintain gas pipes and conduits through and under the surface of the streets, avenues, lanes, alleys and squares of the city of Paterson," will be found in full in the issue of the Paterson *Press*, dated the 22d ult. It is worth reading.

THE following is from the Worcester (Mass.) *Gazette*, of Jan. 18th: "Coke as a fuel on the engines of the long runs has been given up by the Boston & Albany Railroad as a practical failure. There is only one engine in the passenger service between Boston and Worcester on which coke is burned and none of the engines running beyond Springfield uses it any more. As told in the *Gazette* several weeks ago, coke has been unsatisfactory for some time. It has been impossible for the firemen to keep up steam on runs of more than 25 miles, and the result is that the trains were unable to keep up to their schedules. The exception has been the engine on the 10 o'clock train to Boston, which is in charge of Engineer William L. Mason. With this engine there has been some trouble in keeping up steam, but on the whole the result has not been altogether unsatisfactory, so coke will continue to be used on it for the present. The fact that coke had been displaced by coal on the other engines, of course, speaks well for the fireman. On the trains on the Newton circuit, and the runs as far out as South Framingham, coke is an excellent substitute for coal. There has been no trouble in keeping up the steam because it is an easier matter to keep the pressure up on those short runs. It has lessened the discomfort of the passengers to a great extent by getting rid of a great part of the smoke that used to roll back and pour into the coaches every time the doors were opened. It will, of course, be a great advantage to have coke used on these trains, as near Boston, where travel is heaviest, there is the greatest amount of smoke. Worcester people who travel at all will have to put up with the smoke of the soft coal as before, until an improvement on the coke can be found or some other substitute turns up. One of the Boston and Albany firemen explained to a *Gazette* reporter this morning that one of the difficulties with the use of coke has been that the boiler tubes have filled up more than they did when coal was used, and it has been harder to keep them clear. It was necessary, he said, to keep at work on them all the time."

IT is reported that the Central Electric Company, which is doing some construction work at Metuchen, N. J., is anxious to secure control of the Plainfield (N. J.) Gas and Electric Company, with the idea of supplying the important centers of Union and Middlesex counties, N. J., with electric currents. The possession of the Plainfield properties would undoubtedly be a good thing for the Central folks, and they will likely get them if they offer a price therefor that is satisfactory to Mr. H. G. Runkle and his associates.

(*Concluded on page* 174.)

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PROPRIETORS.

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ELBERT P. CALLENDER,
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MONDAY, FEBRUARY 4, 1901.

(*Continued from page* 173.)

THE outlook for a gas supply in Dover, N. J., seems more promising, now that the proprietors of the Gas and Electric Company, of Bergen County, N. J., have taken a hand in the game. Messrs. Poor, Thomas and their associates agree to construct a gas works at Dover fully up to the complete gas supply of that city and the adjoining districts of Rockaway and Port Oram, the net price for gas not to exceed $1.25 per 1,000 cubic feet. The requisite construction would entail an expenditure of perhaps $130,000; but the Bergen County folks would not stop at a much larger expenditure to make their promise good—the complete supply of gas to the three named places. The Dover electrical suppliers might just as well as not make up their minds to this fact. If they do not furnish gas there someone else will; and we know that the Bergen County capitalists are quite up to the fulfilling of such task.

IT is with much satisfaction that we deny the report that Mr. William Hamil, Superintendent of the Hamilton (Ohio) Gas Light and Coke Company, was fatally injured by the accident that disabled him something like a fortnight ago. Although the injuries were painful, and while he will feel their effects for some time, we know that he will be as sturdy and active as ever before the lenten season begins.

THE Youngstown (Ohio) Consolidated Gas and Light Company has authorized the William B. Pollock Company to construct for it a smokestack in connection with its power house, that is to be 9 feet in diameter and 180 feet in height.

THE Directors of the Consolidated Gas and Electric Company, of Batavia, N. Y., have perfected the following organization: President, S. D. Purdy; Vice-President, Jno. H. Ward; Treasurer, Jno. Thomas; Superintendent, E. A. Wakeman. The office of Secretary, made vacant by the resignation of Mr. Russell L. Kinsley, was not filled. The Company proposes to make notable main extensions this spring.

MR. H. ALLEN O'DELL, who had something to do in the east in the gas works line about 3 years ago, especially in the vicinity of Chicopee, Mass., is said to be bargaining for the purchase of the properties of the Louisville (Ky.) Gas Company. Perhaps he is; but he should not lose sight of the fact that the people who own the Louisville Company are quite unlike those that owned the outfit at Chicopee.

THE output of the Detroit Gas Company for the year ended December 31, 1900, is returned at 305,157,510 cubic feet.

AT the annual meeting of the Brattleboro (Vt.) Gas Light Company a dividend of 6 per cent. was declared. The officers elected were: Directors, H. D. Holton, G. C. Averill, J. L. Martin, C. H. Thompson and G. A. Boyden; President, H. D. Holton; Clerk and Treasurer, C. H. Thompson.

THE Cincinnati Edison Electric Company has agreed to submit to its shareholders a proposition for an amendment to its charter permitting it to engage in the manufacture and distribution of gas for any and all purposes for which gas may be used. The meeting for the consideration of the named change in the Company's pursuits is set for the 19th inst.

The Market for Gas Securities.

The market for city gas shares was quiet and steady since last time of writing. Although some fairly large lots of Consolidated were reported as sold, the same trading had much of an appearance of "wash" about it. The opening to-day (Friday) was made at 193 to 193½, and the closing was 193 to 194. At the meeting of the Trustees to perfect executive organization for the year the changes were: Mr. S. Sloan was named to succeed the late Mr. T. K. Lees as Vice-President, and Mr. L. B. Gawtry was chosen Secretary, succeeding Mr. O. F. Zollikoffer, resigned. The latter named gentleman did much good work for the Company in his day and time. There is quite some talk that people prominent in the Consolidated have secured control of the electric lighting of the Borough of Brooklyn. It would be somewhat odd to certain Brooklyn magnates if that were so.

Brooklyn Union is taken up every time that any of it is offered for sale under 180. Peoples, of Chicago, is holding its own fairly well; Bay State is "below" one, and Baltimore Consolidated is heavy at 58 to 58¼. U. G. I. shares show great strength, as they well should under the conditions of the Company's trading.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEBRUARY 4.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	193	194
Central Union, Bonds, 5's.	3,000,000	1,000	108½	109½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	295	299
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	109¼	110
Northern Union, Bonds, 5's.	1,250,000	1,000	104	104½
New York and East River .				
Bonds 1st 5's	3,500,000	1,000	106	106⅜
" 1st Con. 5's	1,500,000	..	115	.
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	130	132
Preferred	5,000,000	100	148	150
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	176	178
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	⅞	1
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works...	450,000	100	28	35
" 1st Mtg. 5's	503,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	68	71
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.	8,500,000	100	194	198
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	58	58¾
Mortgage, 6's	3,600,000	..	..	115
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	16
" Con. Mtg. 5's	380,000	1,000	80	85
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	88	89
" Prior Lien 5's	4,737,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	103	105
" 1st Mtg. 5's	1,225,000	1,000	..	..
Hartford	750,000	25	240	250
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	45
" Bonds, 6's	2 650,000	..	93	95
Jackson Gas Co	250,000	50	70	75
" 1st Mtg. 5's	265,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	8,271,000	100	71	72
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	40	50
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.	400,000	100	60	65
" 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1901	100,000	25	87	89
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	101	101
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,465,000	1,000	88	90½
St. Joseph Gas Co	1,000,000	100	35	40
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	9	11
Bonds	1,612 000	1,000	83½	93
Washington, D. C	2,600,000	20	307½	312½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	97	99
Bonds, 5's	3,830,500	..	107	107½
Wilmington, Del.	600,000	50	200	201

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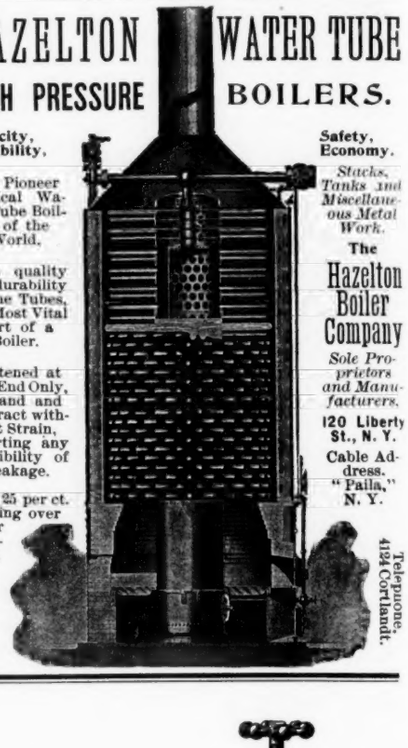

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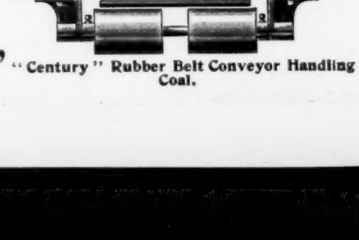

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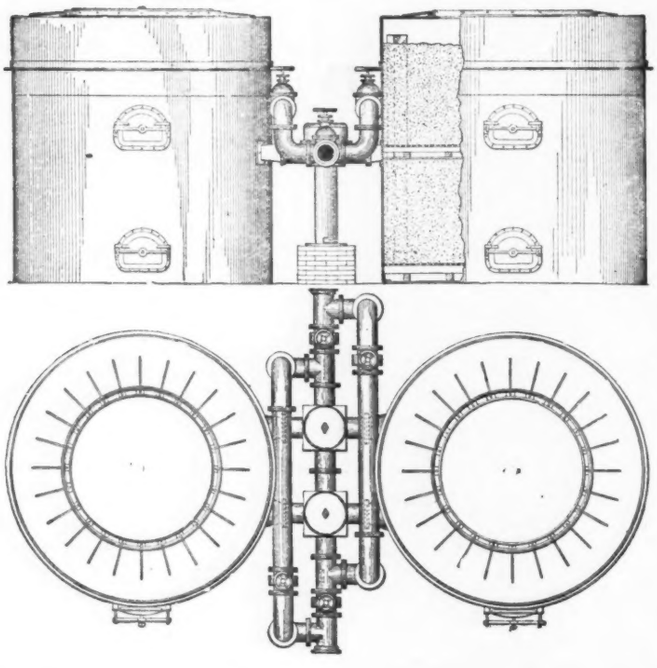

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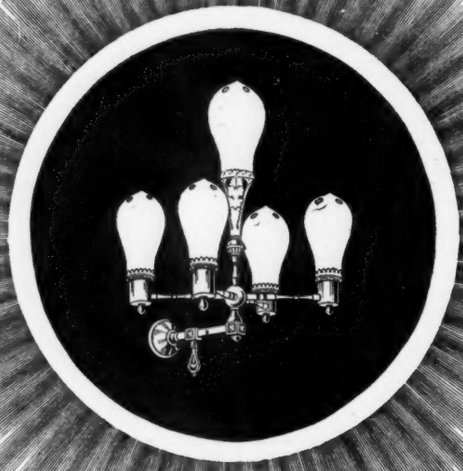

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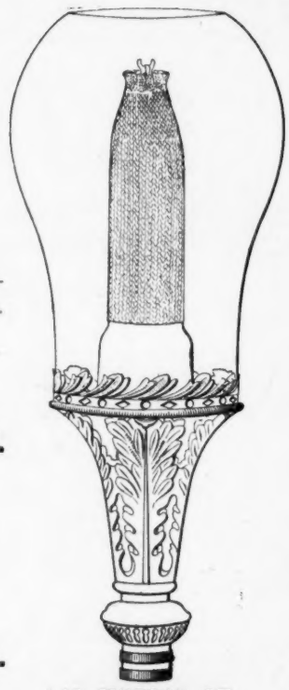

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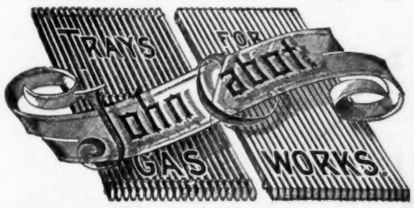

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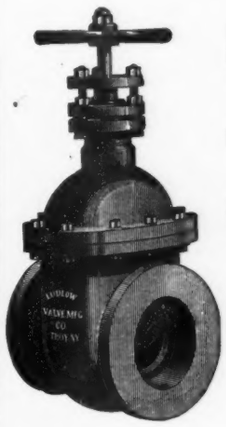

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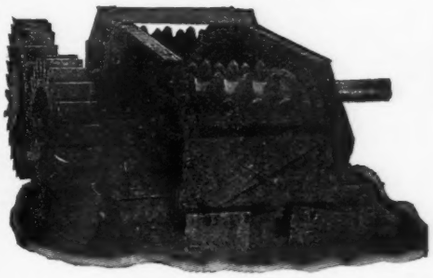

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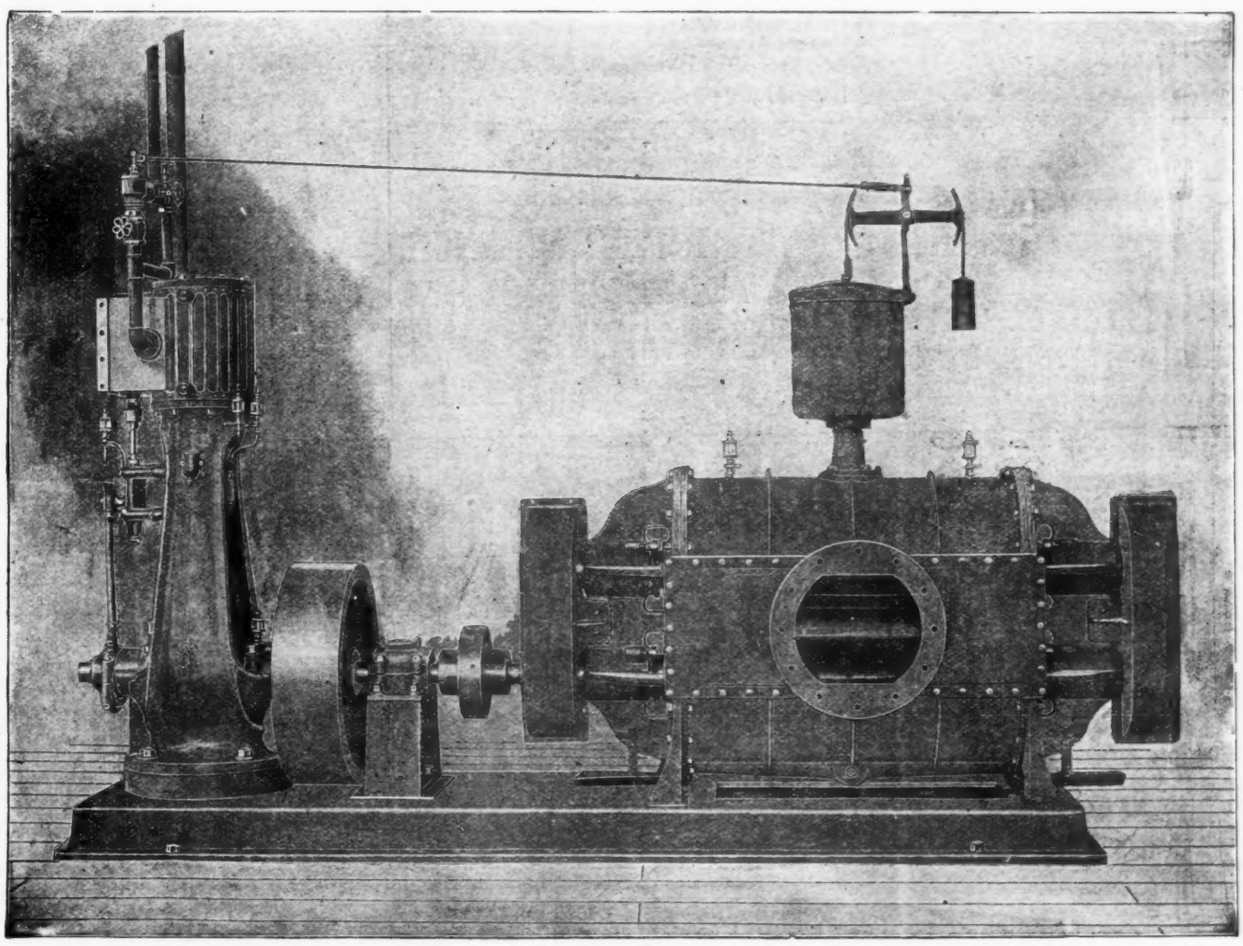

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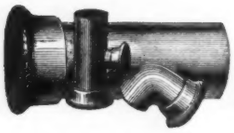

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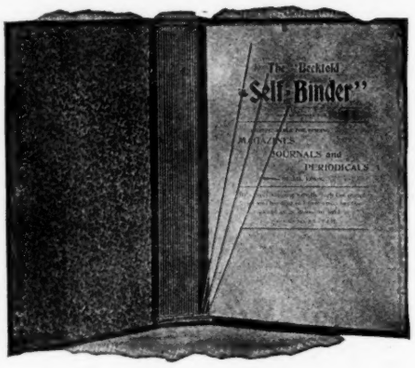

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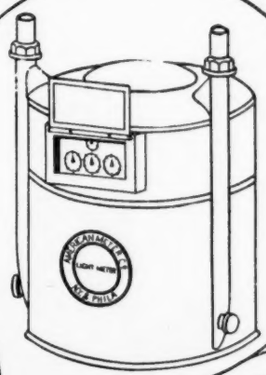

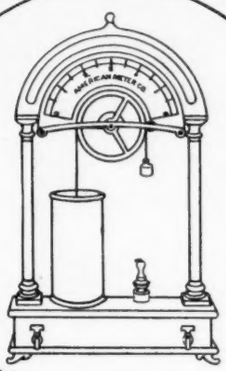

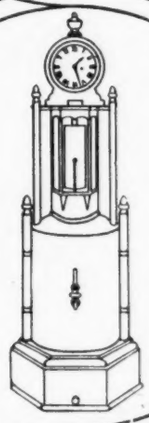

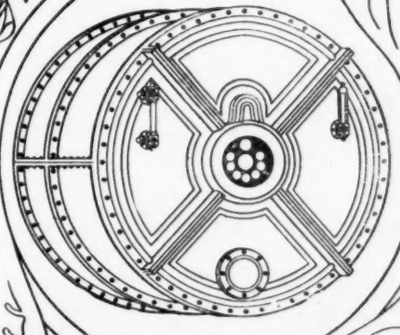

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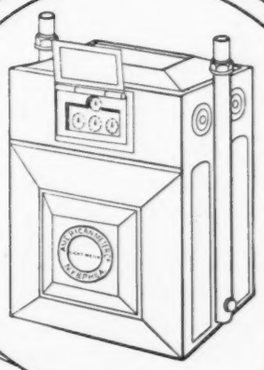
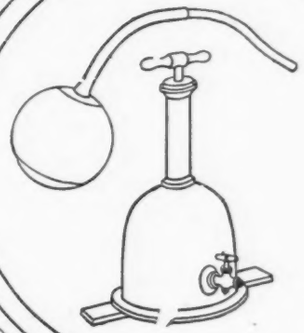
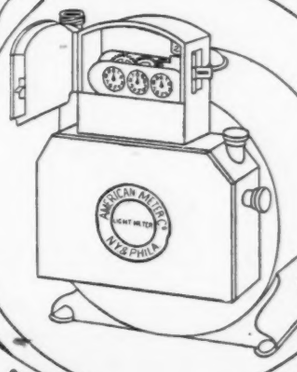






PUBLIC LIGHTING TABLE.

FEBRUARY, 1901.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Fri.	1	5.10 AM	6.10 AM	5.05	6.15
Sat.	2	No L.	No L.	5.05	6.15
Sun.	3	No L. FM	No L.	5.05	6.15
Mon.	4	No L.	No L.	5.05	6.15
Tue.	5	6.00 PM	8.50 PM	5.10	6.10
Wed.	6	6.00	9.40	5.10	6.10
Thu.	7	6.00	10.40	5.10	6.10
Fri.	8	6.00	11.40	5.10	6.10
Sat.	9	6.00	12.30 AM	5.10	6.10
Sun.	10	6.00	1.30	5.10	6.10
Mon.	11	6.00 LQ	2.30	5.10	6.10
Tue.	12	6.00	3.20	5.20	5.55
Wed.	13	6.00	4.10	5.20	5.55
Thu.	14	6.00	5.00	5.20	5.55
Fri.	15	6.00	5.50	5.20	5.55
Sat.	16	6.00	5.50	5.20	5.55
Sun.	17	6.10	5.50	5.20	5.55
Mon.	18	6.10 NM	5.50	5.20	5.55
Tue.	19	6.10	5.50	5.30	5.55
Wed.	20	6.10	5.50	5.30	5.55
Thu.	21	6.10	5.50	5.30	5.55
Fri.	22	6.10	5.50	5.30	5.55
Sat.	23	10.30	5.50	5.30	5.55
Sun.	24	11.40	5.40	5.30	5.55
Mon.	25	12.40 AM FQ	5.40	5.30	5.55
Tue.	26	1.40	5.40	5.30	5.45
Wed.	27	2.30	5.40	5.30	5.45
Thu.	28	3.10	5.40	5.30	5.45

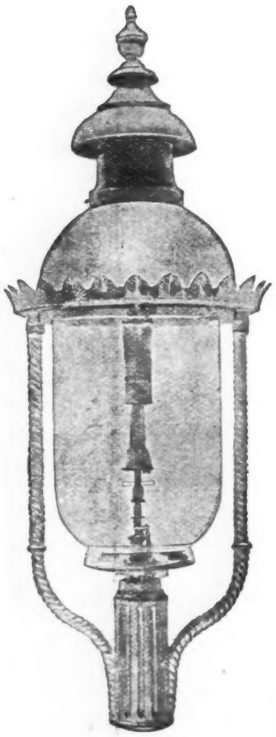
TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....



No. 36.

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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

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By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

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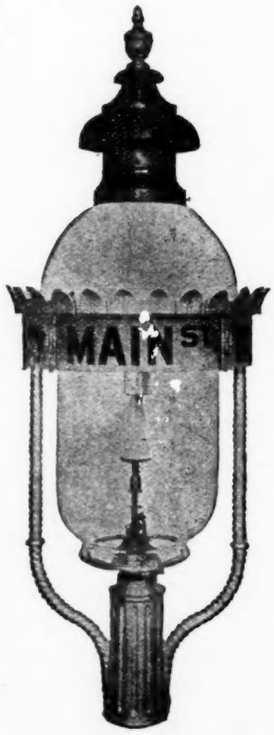
Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



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FINEST EXAMPLE

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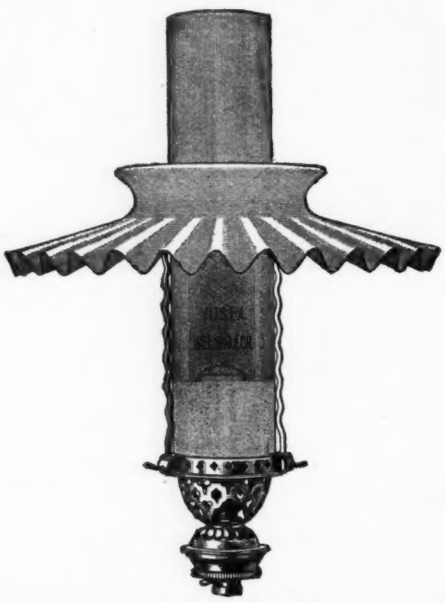
GAS LIGHT

EVER EXHIBITED.



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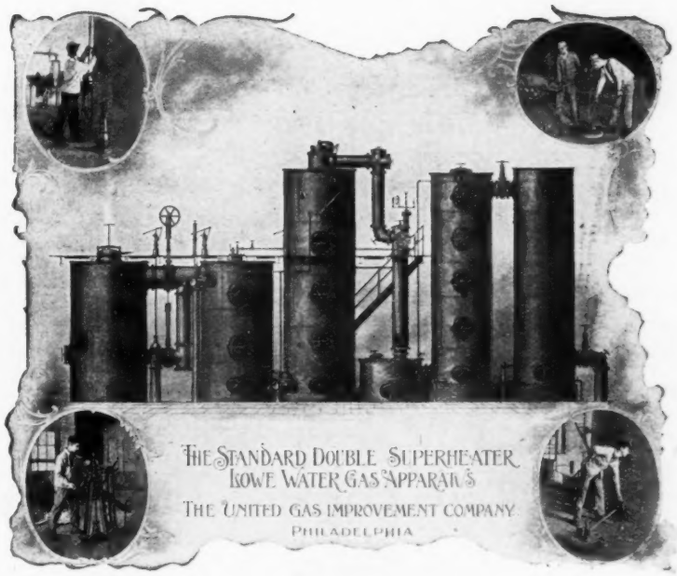
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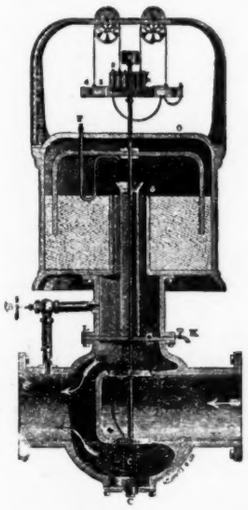

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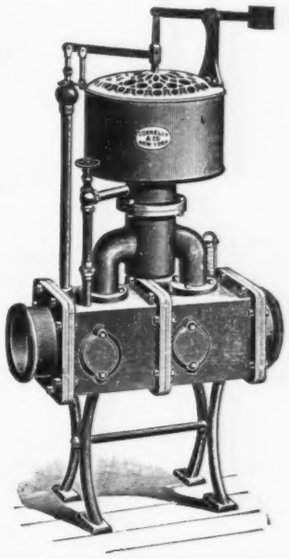

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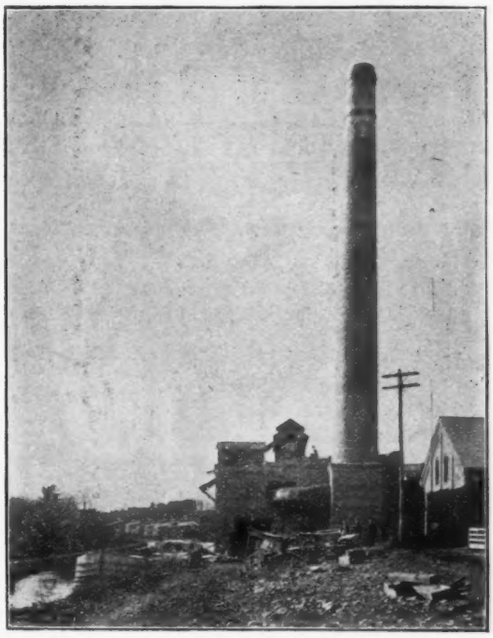

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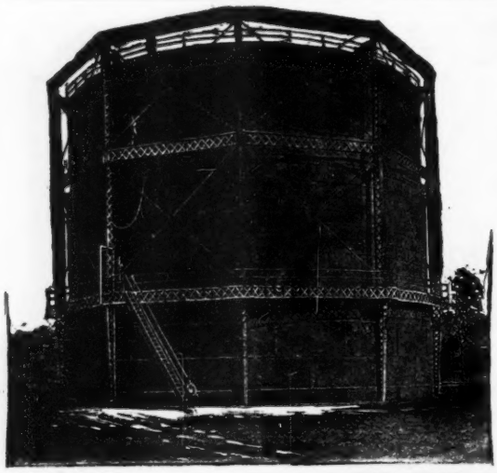

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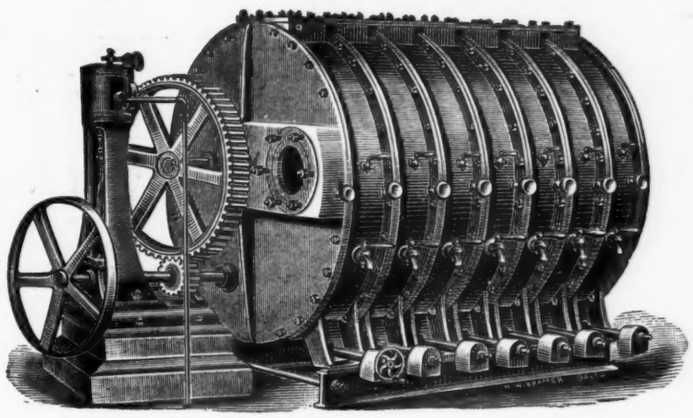

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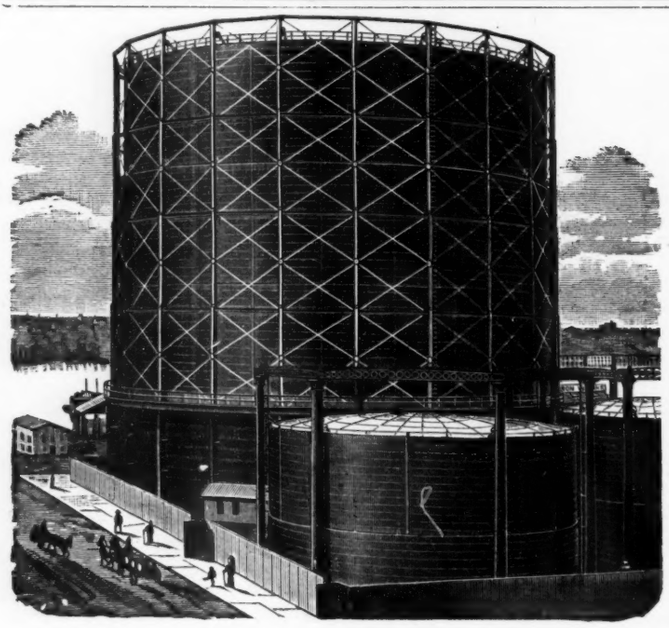

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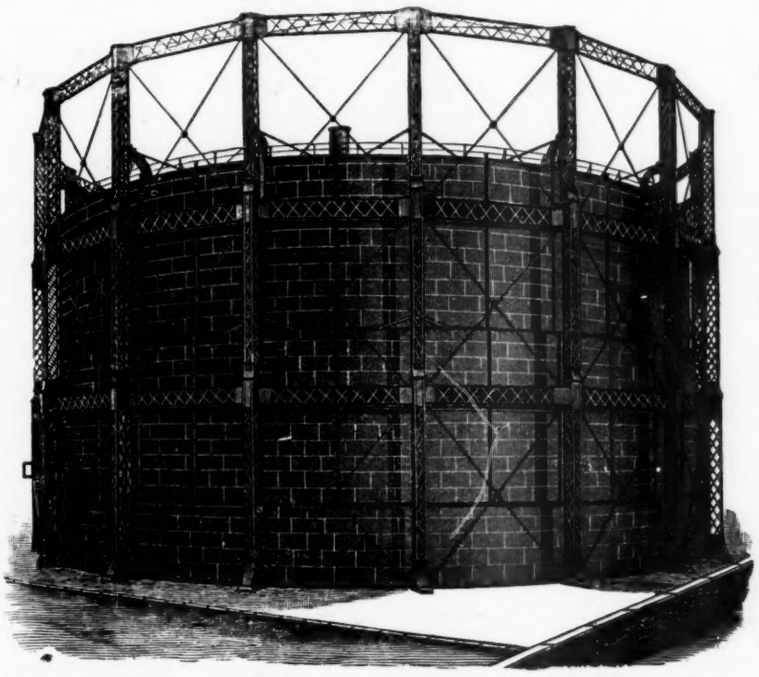

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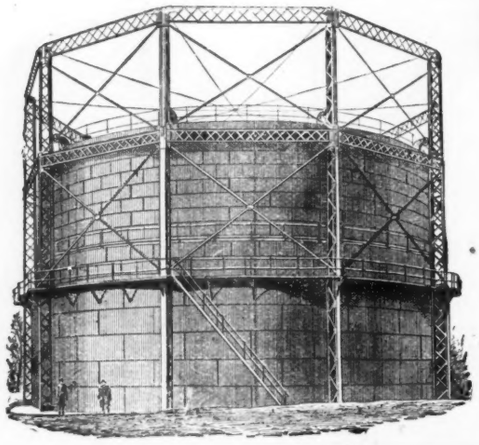

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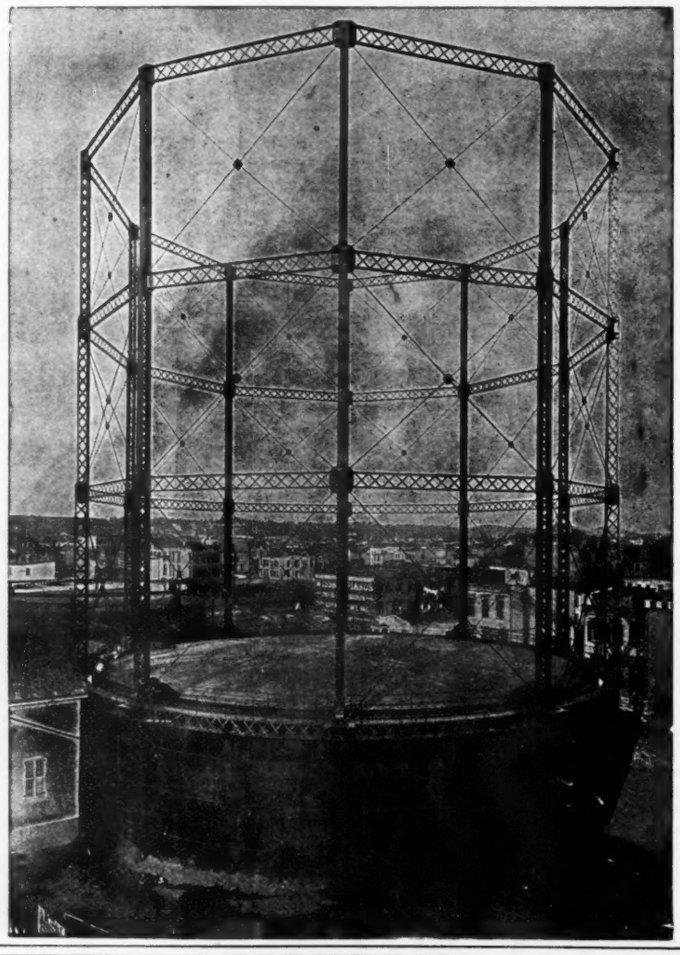

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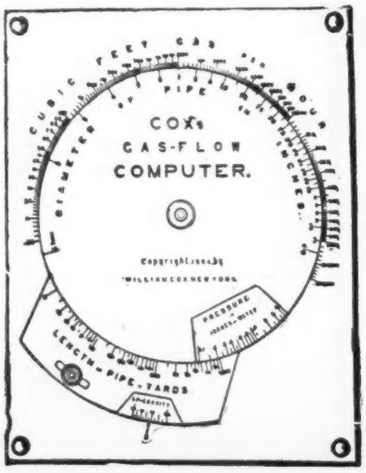

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